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Electrical World

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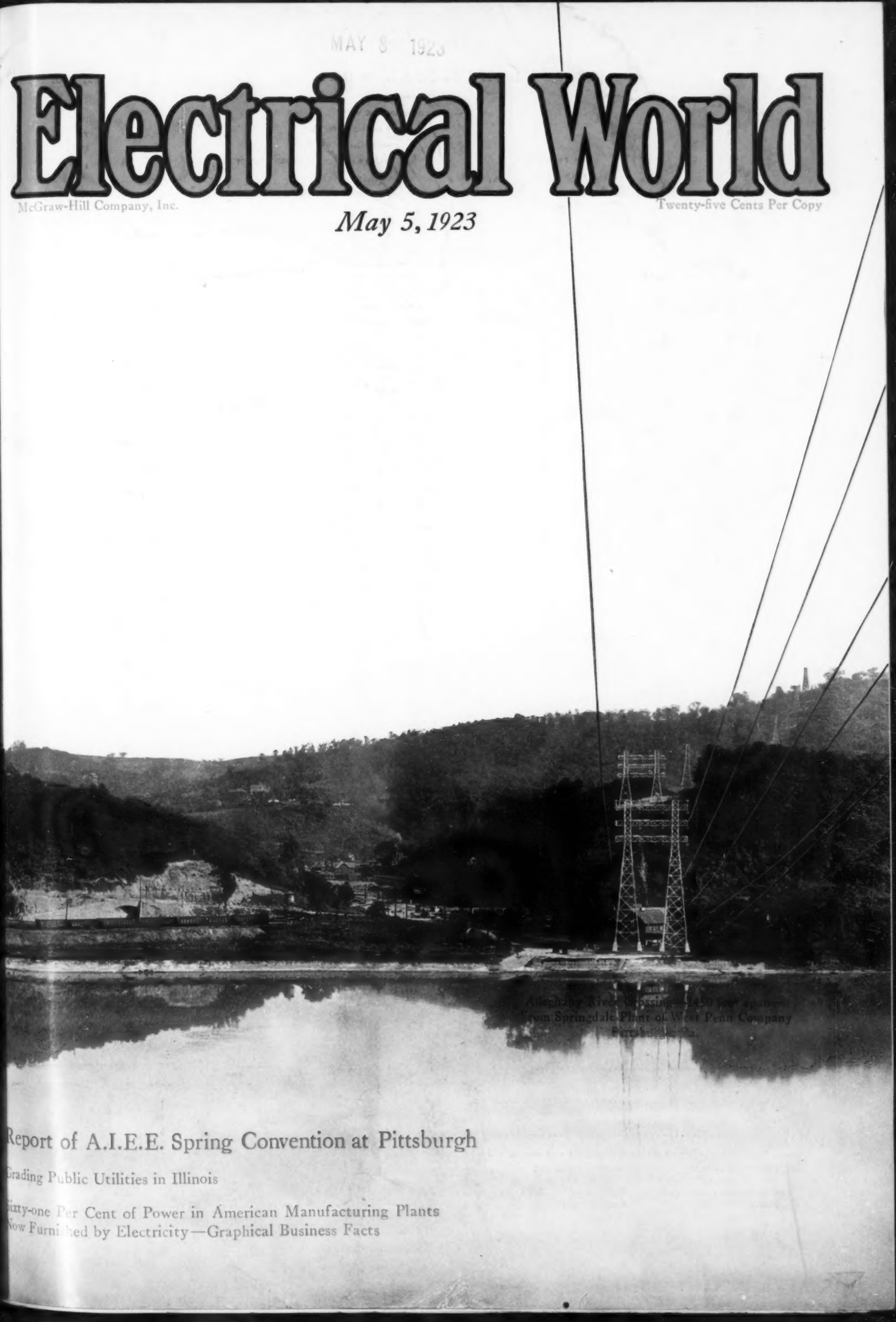

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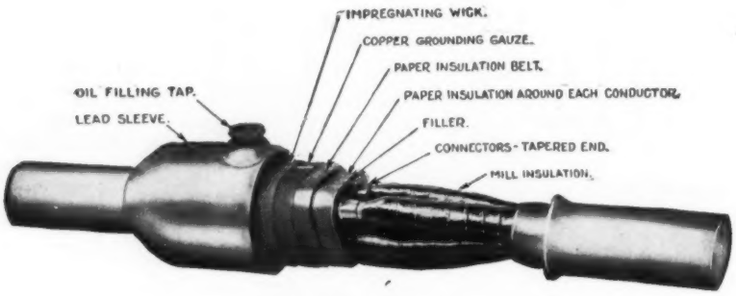

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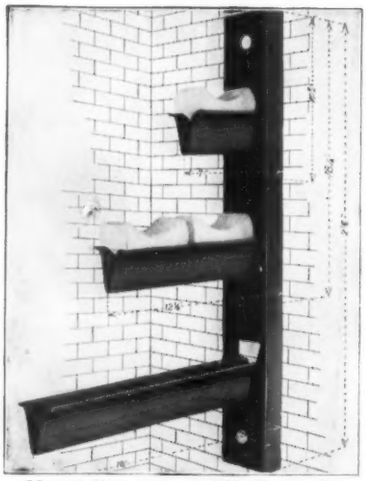

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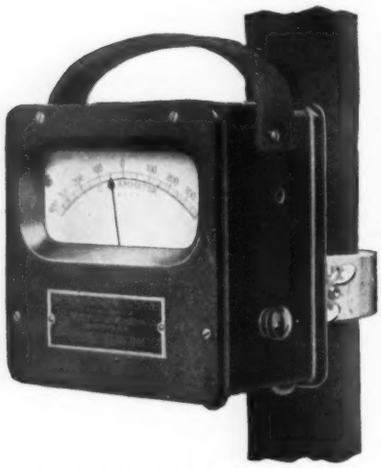

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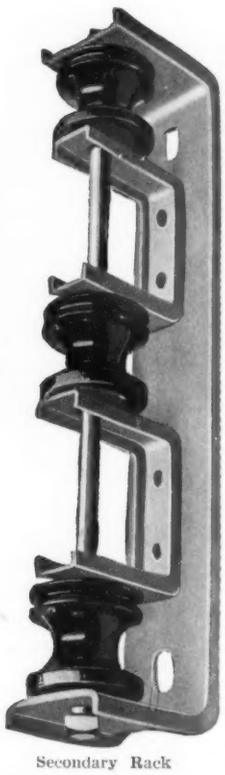

Secondary Rack

Electrical World

The consolidation of Electrical World, Electrical Engineer and American Electrician

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W. H. ONKEN, JR. Editor

HAROLD V. BOZELL Editor

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Making Progress by Mingling Theory with Practice

THAT theory and practice can mix —and much to the advantage of the electrical industry—was strikingly shown at the spring convention of the American Institute of Electrical Engineers, held last week in Pittsburgh. Nearly twelve hundred electrical engineers were gathered there to take part in or listen to a program which contained both highly technical and highly practical papers, and the results showed conclusively that the practical or operating engineer and the technical specialist can meet jointly and discuss their problems and experiences to mutual advantage.

The story of the convention, with the details of its papers and discussions, is told elsewhere in these pages. It is enough to point out here that essentially the convention, in its technical aspects, was an exposition of some important operating problems of the light and power industry and that it was notable for the presentation of many papers filled with data obtained in the field. A judicious selection of theoretical and technical papers added vitality to the discussion, and there was thus formed a well-proportioned picture of the subjects under consideration. Agreement was expressed on the advantages of operating with a grounded-neutral system; the field for application of the neutral grounding reactor was defined, and a great deal of progress in relay design and application was shown. In addition, outstanding progress in illuminating engineering practice was evidenced, and a noteworthy revival of interest in the design and application of electric furnaces was evident.

BUT, while the details are of interest, most important is the fact that a general feeling of power to accomplish and of confidence and optimism concerning the future was quite evident. Many hitherto vexatious engineering problems have been solved. In fact, as M. H. Aylesworth observed in his banquet address, the status of electrical engineering has advanced so rapidly that the realization of an electrified America is delayed, not by lack of engineering knowledge and ability, but only by legal, economic, social and political handicaps. In other words, while there is real engineering work to do, yet from the viewpoint of engineering, superpower is an easy task.

Thus have the co-operative thinking and the personal contact of the electrical engineers made for progress. Engineers of groups from separate commercial divisions, with operating, manufacturing, or theoretical training and experience, meet together as unbiased professional men and discuss their problems in a friendly and constructive spirit. It is worth noting, too, that the younger engineers took an unusually prominent part in the meetings. More of the mingling of theory and practice would seem advisable to attain the maximum of progress in engineering work for the electrical industry.

Otto Herbert Falk

A manufacturing executive who adds to his commercial leadership by participating actively in public affairs

AS CHIEF executive of the Allis-Chalmers Manufacturing Company since 1913 General Otto H. Falk has become an important factor in the electrical manufacturing field, where that company plays so prominent a part. Ten years ago the affairs of the company became involved, and the banking houses concerned turned to General Falk, who has large financial interests in Milwaukee, as a man eminently fitted to shoulder the responsibility of clearing up the situation. He became receiver of the company in 1912, and on its reorganization in 1913 he was made its president. It is to his ability in handling financial affairs that the Allis-Chalmers Manufacturing Company owes its present-day position as a producer of electrical, hydraulic and other machinery.

General Falk is a native of Wisconsin, having been born in Milwaukee in 1865. After receiving collegiate training in Northwestern College at Watertown, Wis., military tastes led him to become a pupil in the Allen Military Academy of Chicago, from which he was graduated as ranking captain in 1884. Ever since 1886 he has been an active factor in Wisconsin military affairs, stepping rapidly from grade to grade. In 1893 he was appointed adjutant general of the Wisconsin State militia. He was called into active service during the Spanish-American War, at which time he was commissioned as major and chief quartermaster. On his discharge he again became active in the Wisconsin National Guard, retiring with the rank of brigadier-general in 1911.

General Falk, in addition to his financial and military interests, is an important factor in Milwaukee's civic, social and business affairs. For a long time he was president of the Merchants & Manufacturers' Association of Milwaukee, serving on its legislative committee and becoming a member of the charter convention and chairman of the track elevation committee. He is a regent of Marquette University, and he has been fire and police commissioner of Milwaukee, vice-president of the public safety committee, and a delegate to national conferences on many important matters.

Editorial Comment

Electrical World, May 5, 1923

Volume 81 Number 18

Regulation Responsive to Public Opinion

A MOST interesting address was delivered by L. F. Loree, president of the Delaware & Hudson Company, at the centennial celebration of the chartering of that railroad. The vital part of the address comprised a peppery criticism of our system of regulation, which Mr. Loree stigmatizes as "repugnant to the genius of American political ideals and institutions." We do not so read history or interpret it. It may be that "railroading is no longer a business, it has become a calamity," but that view certainly does not hold for the electric light and power industry. Nor, indeed, would the railroads find it so if they took a more optimistic view of conditions and paid a little more attention to public relations. Every one recognizes that the railroads are vitally essential. No one seeks to destroy them or willingly wishes to cripple them. If they are maltreated, the fault rests with the railroads themselves. We have found regulation to be exceedingly responsive to public opinion, and that, properly enlightened, is constructive and not destructive. If the viewpoint of the railroads is otherwise, they should seek enlightenment and change their thought. Optimism and faith have been known to work miracles.

Cost of Living and Price of Electricity

INDEX figures showing changes in the cost of living have been published for some years by the Labor Bureau in Washington and by special departments in various other countries of the world, as well as by private bureaus. The government's index figures are predicated on the normal household budget of the average workingman for food, clothing, housing, fuel, light, household goods, etc., compared with the cost of similar commodities in 1914, which year is used as a base. These serve a useful purpose and are employed principally in establishing wage scales. In the published tables and curves fuel and light are combined, and while the curve tells a true story, it does an injustice to the electric light and power industry, because, while the combination shows a large increase, the cost of electricity may have actually decreased. This, of course, is of no concern to the agitator or the yellow press, either or both of whom will, when it serves their purpose, quote the official figures as if they pertained to light only.

Fortunately, the Bureau of Labor Statistics is headed by a broad-gaged commissioner, Ethelbert Stewart. Mr. Stewart, when the matter was brought to his attention, recognized how unjust such a grouping was to a regulated industry. Accordingly he set about to right the wrong, and in the digest given to the daily press last week a note was added showing the percentage of increase or decrease in the price of electricity at specified dates compared with the price in December, 1914. The figures, which are based on simple averages of primary rates, show that while fuel and light cost 86.2 per cent more in March, 1923, than in December, 1914, electricity actually cost 2.4 per cent less. In fact, with the exception of the quarter ended December, 1920, which showed the slight increase of 1.2 per cent in the cost of electricity, all other quarterly periods since 1914 show a decrease ranging from 4.8 per cent to 1.2 per cent, the cost of fuel and light during that same period having increased from 24.1 per cent in December, 1917, to 86.2 per cent in March, 1923. The government's figures speak for themselves and the electrical industry takes commendable pride in them.

Give Us the New Code—Now!

SOME very constructive changes have been made in the National Electrical Code, and a general revision in the phrasing and arrangement of the code is now in process. There is a question, however, as to how and when to put the new rules into effect. The authorized changes offer considerable advantage to the public in the wiring of private houses. Naturally, therefore, owners and contractors desire to apply them at once. Dana Pierce, chairman of the electrical committee of the National Board of Fire Underwriters, wrote a letter to the ELECTRICAL WORLD, which was published on April 14, to answer publicly the "numerous inquiries" he is receiving as to whether these changes were now operative. Mr. Pierce stated that the new code embodying the revision would be printed and made ready as soon as possible, but that he could not say when it would be issued. He gave it as his opinion, however, that it would be best if the 1920 code remained in effect until the 1923 edition is out.

R. S. Hale, in this issue, challenges the policy advocated by Mr. Pierce, asking whether the inspection department must wait upon the convenience of the printer without regard to the interests of the public. Should the inspector, he asks, "forbid certain forms of construction not because they are unsafe but merely because a certain book has not been printed"? It would seem that this point is well taken, and particularly in view of the fact, which Mr. Pierce himself stressed, that, anyway, each inspection department will "decide for itself" when it will begin to operate the new code after it is formally received.

Now, it so happens that the American people are at present engaged in the largest building program in history. About four billion dollars is to be spent, it is estimated, and of this at least 3 per cent, or $120,000,000, will be paid out for electrical construction. The important question is: Are the men and women who

will be investing their money in new buildings to have the benefits which the new changes in the code make possible to them or must it be withheld? The whole purpose of the code is, after all, to guide the owner, architect, contractor and insurance underwriter to safety in electrical construction, but the interests of the owner assuredly come first, by weight of numbers if for no other reason.

The issue should be decided, therefore, purely on the basis of safety. If the new accepted rules are safe, then in common justice they should apply to houses now building as well as to those other houses which will be building later on when the printer of the revised code book has finished his work. Meanwhile the principal revisions have been published in the ELECTRICAL WORLD (March 24) and other papers, so that they are not unknown to the inspectors and other concerns. Some additional means should be found to place the new rules in the hands of all inspectors immediately in temporary form pending the publication of the 1923 code, and they should be encouraged to apply them so that the American people may have the benefit of them now while they are most needed.

Railroad Electrification Discussed on Higher Plane

RECENT discussions by electrical engineers on the subject of railroad electrification show that this question is at last being considered from the standpoint of those who operate the railroads. The most recent appearance of the subject was at the Pittsburgh A. I. E. E. convention last week, when a short discussion pointed directly to the fact that the transportation advantages and economies other than fuel economies were really the deciding factors.

A. H. Babcock's paper at the meeting was a worth-while contribution to the subject of relative fuel consumption by steam and electric locomotives, adding to the material presented a year or so ago at a joint meeting of the engineering societies. Although Dr. Cary T. Hutchinson questioned some of the conclusions from the results, yet the principal point finally made by W. J. Davis, and agreed to by R. S. Twogood, Mr. Babcock's representative, was that fuel economy would never be the determining factor, except as water power might enter as an element of conservation. The facts which will be considered by the railroad executives are those having to do with improvement of transportation, greater usage of tracks, reduced locomotive maintenance, reduced wages per train-mile and per ton-mile, reduced maintenance-of-way expenditures, etc., and greater dependability of continued safe and reliable service.

Not once was "A. C. versus D. C." mentioned. Engineers know that they can do the necessary engineering, make the necessary engineering decisions on any individual electrification problem. They are realizing that what really counts is the fact that electrification pays. There will doubtless be further discussion by engineers on the technical features of electrification —it would be too bad if there were none. But, whether or not present developments will lead to a common system, as they may, the future discussions of electrification should be, and doubtless will be, on a plane to promote it on its logical basis—improvement of transportation.

Twelve Hundred Pounds Steam Pressure for Boston

THE expected use of steam pressures approximating 1,200 pounds per square inch in one of the boilers and in one small turbine in the new Weymouth station of the Boston Edison company marks another daring advance in engineering and serves again to focus attention upon the problems of boiler, turbine and fittings design which must be solved in order to reap the reward of this pioneer work in the field of generating-plant development. In the near future more particulars of this equipment will doubtless be available, but the outline printed in the news columns of this issue challenges one's interest because of the ingenious use of high-pressure and medium-pressure turbines, high-pressure and medium-pressure boilers and skillfully arranged superheaters that is proposed.

The thermodynamic analysis of these problems offers a fascinating and intensely practical field of study; the prospective economies of these units and the metallurgical progress which must be in reach to insure guarantees of commercial success in such a radically advanced development arouse the curiosity of the engineer and the utility executive alike, and the pioneering spirit of the Boston company, its consultants and the equipment builders deserve the commendation of the industry. The difficulties of so great a step forward appear very formidable, but the resources of American engineers are many and are seldom found more wanting in crises of equipment development than in emergencies of operation. The whole world of engineering will wish the fullest success to these laudable efforts to set a new standard of generating-plant design before the profession.

Relativity and the Electrical Engineer

ACCORDING to recent press dispatches, the agreement between Einstein's theory of relativity and the actually observed astronomical facts is so close that no more money will be appropriated for costly expeditions to remote parts of the earth to test this theory. It is also well known that the motion of electrons in a vacuum tube checks well with the values deduced from the theory of relativity, and that this theory gives correct results for the propagation of electromagnetic waves in moving media.

The electrical engineer of a not far distant future will be directly concerned with the motion of electrons in all kinds of vacuum rectifiers, amplifiers, oscillators, etc.; in the ionization fields around extra-high-tension conductors, and in the study of liquid and solid dielectrics. And while it would be rather optimistic to expect many of the present generation of engineers to take up the study of relativity for the purpose of using it in their work, yet the oncoming generation of engineers, or at least its ablest theoretically inclined members, should be acquainted with the possibilities of this wonderful new analytical tool.

The motion of an electron is particularly interesting from the point of view of relativity. According to this theory, the values of the intensities of the electrostatic field and the magnetic field at a point depend entirely upon the velocity of the observer himself with respect to this point. Simple equations are available which connect these intensities as measured by a stationary

observer with those measured by a moving observer. Thus, in the case of a moving electron one needs only to imagine an observer moving with it and recording his measurements. But to such an observer the electron appears stationary; there is no magnetic field, and the electrostatic field is simply radial. Now, by means of the general equations it is possible to recompute these results in terms of a stationary observer and thus obtain the space distribution of the magnetic and electric fields due to a moving electron. The results check with those obtained in the old-fashioned way, and there is a considerable economy of mental effort and of formal mathematics.

Philosophers have taught for long centuries that space and time are but phenomenal concepts of our limited minds, the channels through which we perceive the universe. They have claimed that the Absolute Being needs no time or space because it sees the whole creation directly from minus infinity to plus infinity as one idea and its harmonious realization. Such a being needs no origin of co-ordinates and no zero time. At low velocities these two channels or modes of perception of phenomena—viz., space and time—have been found by humanity to be independent of each other. There is, however, no logical inconsistency in assuming space and time to be interdependent at high velocities, especially seeing that the results based on such an assumption agree with the observed facts.

Not long ago it was shown that the complicated phenomena in electrical machinery and lines can be represented by simple kinematic models. Perhaps some one will invent a combination of sticks and cogwheels which will show to the timid mind at a glance that the amounts of space and time involved in a given phenomenon depend entirely on the velocity of the observer who is describing the phenomenon.

Where to Stop in Adding Refinements

IN THE desire to obtain low operating expense there is always danger of investing money for refinements that increase the fixed charges more than they reduce the operating expense. Furthermore, there is always the possibility that in adopting too many refinements the tail may some day wag the dog. A truth often expressed and well known by students of economy is that the best installation is the one which has fixed charges equal to the operating expense. Of course, this statement is subject to modification as conditions develop.

The point to be made is that the most economical plant is not necessarily the one which burns the smallest amount of coal per kilowatt-hour or generates a kilowatt-hour at the least operating expense exclusive of fixed charges. Still, this is the comparison often used. The only criterion of economy is how many kilowatt-hours can be got out of a plant, year in year out, per dollar of production expense, including fixed charges. With this in view, the real engineer, before copying other practices, makes it a point to study different plant arrangements, not in the aggregate but in parts, to determine whether changing this or that equipment or arrangement would reduce the sum of the operating expense and fixed charges. More extensive emulation of this practice might shorten the procession now playing "follow the leader."

New Thoughts on Electric Furnaces

THE electric furnace has "made good" in the production of steel in competition with other methods, but recent investigations indicate that its full possibilities in the production of alloys have not been realized. Apparently there is ground for assuming that the electromagnetic effect of the electric current has a decided bearing on the metallurgical processes which occur during refining. How much the reaction of the field on the atomic constituents of the furnace charge can be utilized is a subject for further investigation. But if there is a possibility of obtaining new or better alloys by subjecting the charge to the influence of a strong field during cooling, a remarkable opportunity exists for further furnace applications.

Experimental evidence indicates that the electric furnace does things which cannot be explained on a thermal basis. For example, forced circulation by using the magnetic field has made the induction furnace a commercial possibility, and in many other applications the mixing of the constituents of the charge is best explained by the field effect on the atomic structures.

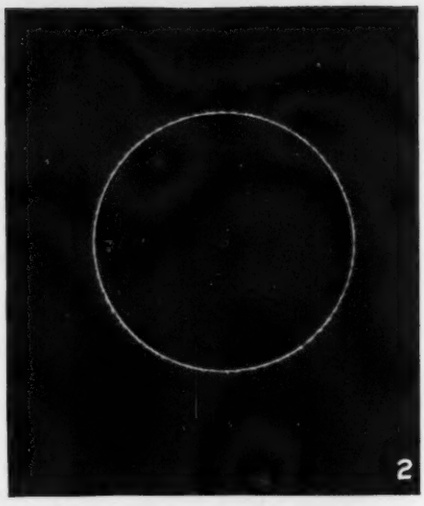
Although the subject is still rather speculative, it is quite fascinating to think that electricity may make possible the production of ferro-alloys without the use of tungsten, vanadium, manganese or other expensive constituents, and the electrical industry awaits with interest new data on the metallurgical effects which can be obtained by further work in the electric furnace.

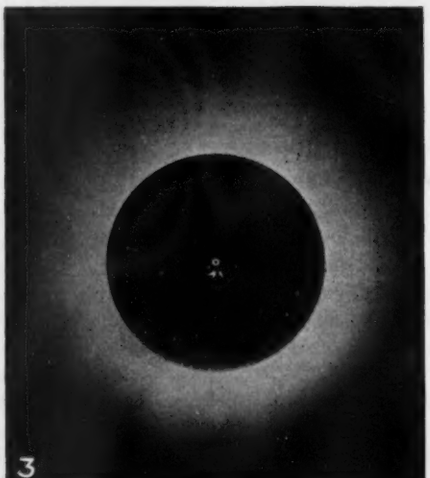
Illinois Grading Its Utilities According to Service

A SYSTEM of grading the electric utilities of Illinois according to their service accomplishments has been adopted by the Commerce Commission of that state and affords an indication of the way in which public demands for good service are working out. Most of the state commissions have rules of some sort covering service standards, but in large degree these rules are a dead letter until insistent complaint stirs up the commission. The ceaseless inspection necessary to make them an always active force is too great a task. The Illinois grading system is intended to provide just such an active force and to forestall public complaint by removing the causes of criticism. The grading goes so far as to take into consideration the attitude of the public toward the utility and the willingness with which utilities meet complaints and remedy faults, as well as the attitude of the utility in dealing with its customers.

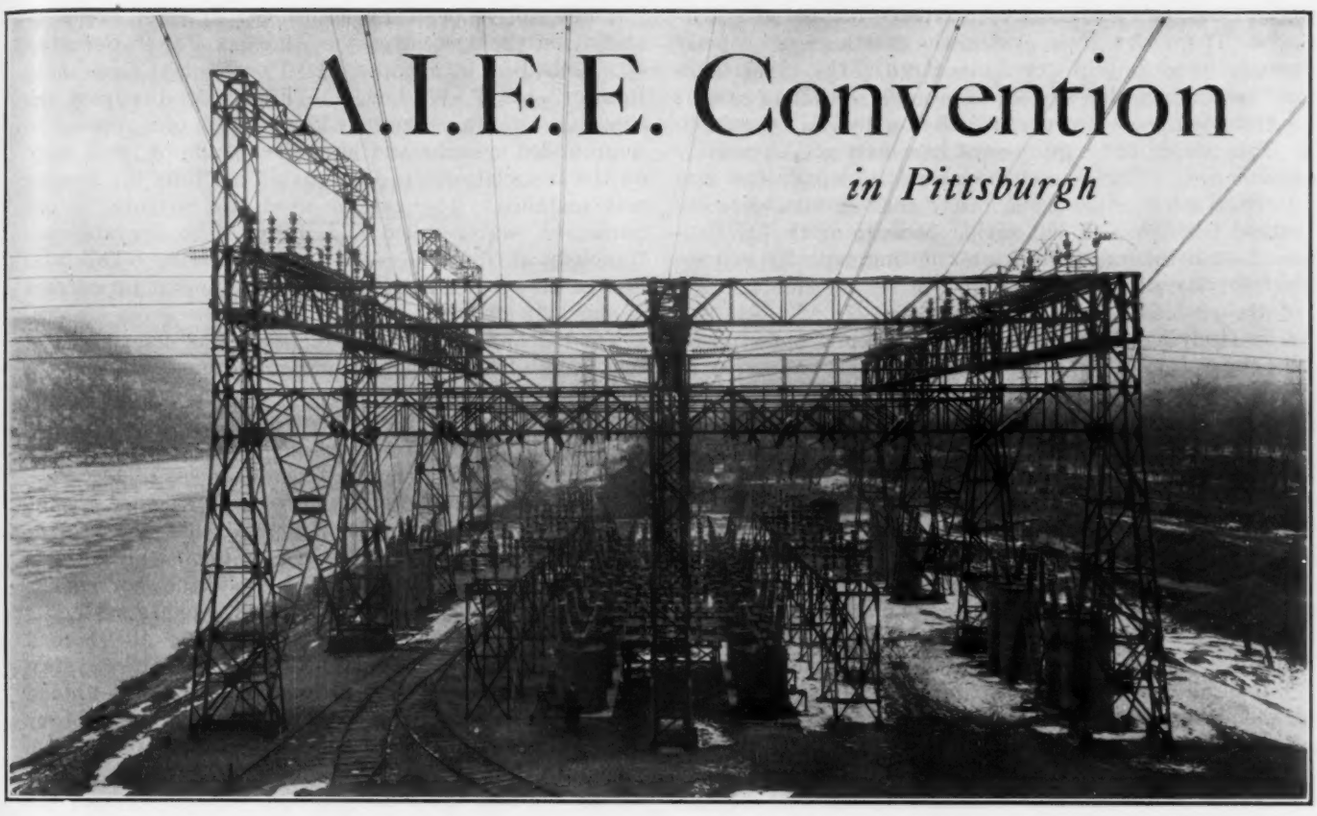
A great many utility men will criticise the system as an unwarranted interference with their affairs, but the impartial reader of the instructions under which the grading is carried on will be inclined to agree that a careful study of its results and appropriate action thereon will put any utility on a better footing with its own public. The instructions indicate a thoughtful and impartial effort to promote good service, and it would not be amiss if every central-station executive in the country were to have such a grading of his plant laid on his desk periodically. It would reveal surprising and disconcerting weaknesses as well as the strong and gratifying points in his organization. The Illinois grading system is not the last word in such matters, but it is worth a great deal of hard study.

Corona Photography with Quartz Lens





THROUGH the use of quartz lenses it is now possible to study arc and corona formation much more thoroughly than heretofore. Some comparisons are made in the accompanying illustrations: Figs. 1 and 4 show simultaneous photographs of a 14-ft. 1,500,000-volt arc with a glass lens and a quartz lens. The first shows only a lace-like tracery, whereas the latter shows the ultra-violet light as well. Figs. 2 and 3 are fifteen-second exposures with glass and quartz lenses. The latter shows corona extending 27½ in. beyond the 36-in. circle, whereas the glass lens shows only brush discharge. These photographs were taken in the Pittsfield research laboratory of the General Electric Company.



A.I.E.E. Convention *in Pittsburgh*

Operating Experience Presented in Notable Papers — Grounding Devices, Relays, Furnaces, Insulators, Railroad Electrification and Illumination Discussed from Practical Standpoint

THE unprecedented expansion in the light and power industry was reflected in the atmosphere at the Pittsburgh meeting of the American Institute of Electrical Engineers on April 24-27. A spirit of optimism and expansion was current, and the successful program and skillfully conducted convention accented the feeling of confidence in the future of electric power. Nearly twelve hundred engineers assembled from widely separated properties and discussed the technical features of equipment and the practical features of operation associated with transmission, distribution and utilization of electric power.

The papers and the discussions clearly indicated the ability of the engineers in the light and power industry to meet the present and future engineering problems connected with a greater use of power on a national scale. Many heretofore controversial questions were recorded as answered, and the thoughts of the engineers were directed toward new problems and toward new equipment.

Operation of Grounded Systems

The trend of present practice, as reported by the sub-committee on grounding of protective devices (E. C. Stone, chairman), is definitely toward the grounding of neutrals on large transmission systems. This conclusion was drawn from an analysis of thirty-six systems having an aggregate generating capacity of 6,371,850 kva. and a transmission mileage of 31,408. Increasing mileage and voltage have been the factors necessitating the practice described. On systems transmitting at generated voltage the neutral usually is grounded at each generating station with resistance of low value. On systems transmitting at higher than generated voltage the neutrals of the transformers are dead-grounded at each generating station and some or all substations. Where resistances are used they are generally made up of cast-iron grids with time ratings at maximum current of thirty seconds to sixty seconds.

On systems transmitting at generated voltage the relation between the voltage and value of neutral resistance is fairly consistent and is usually identical with the maximum ground fault current which could exist, assuming that the resistance and reactance of the return circuit from fault to ground connection was zero and that the voltage at the fault was held at normal. When ground relays are used the neutral resistance is generally higher than when using phase relays.

In the last few years there has been a fairly marked trend toward the use of higher resistance in grounded neutrals, especially in the higher-voltage systems. This has led to the development of a number of relay schemes in which selective operation of breakers is obtained with ground currents less than the full-load current of the line. Six companies are using schemes of this nature on parts of their system.

The most recent development in methods of ground-

ing of neutrals is the use of reactance instead of resistance. If for any given system the reactance is properly proportioned it will exactly neutralize the capacitance of the transmission system to ground, so that in case of a grounded phase no current will flow through the fault.

The use of arc suppressors has been very generally abandoned. That is not because such apparatus was without merit, since some fairly good results were obtained with its use, but rather because of the development of breakers of high interrupting capacity and selective relays, which are found to be a better solution of the problem.

In studying the effects of heavy ground currents on the operation of synchronous machinery a series of tests was made by one of the manufacturers under conditions approximating those of a certain transmission system. The results of this test indicate that the average voltage at the motor could not drop more than 30 per cent without interference with operation.

Grounding the neutral has proved successful to a very high degree in limiting trouble from excessive voltage on transmission systems. Case after case is on record where frequent and destructive insulation breakdowns on systems operating underground have been virtually eliminated after the neutral has been grounded.

General considerations in grounding the neutral of transmission systems were the subject of a paper by H. H. Dewey. The author pointed to the fact that in grounding overhead systems the tendency is toward the use of low resistance values, while in underground cable systems the trend is toward the use of resistance in the ground connection. The general conditions on the two systems are very similar, and the author thought there were no very good reasons for the differences in grounding practice.

SUMMARY OF GROUNDING PRACTICE

	Systems at Generated Voltage	Systems at Higher Than Generated Voltage	All Systems
Number of companies	20	32	36*
Number of systems:			
Ungrounded	11	31	42
Dead-grounded	3	39	42
Resistance-ground	17	9	26
Reactance ground	0	1	1
Total	31	80	111
Total mileage:			
Ungrounded	1,008	5,377	6,385
Dead-grounded	3,797	14,678	18,475
Resistanceground	3,822	2,626	6,448
Reactance ground	0	100	100
Total	8,627	22,781	31,408
Average mileage:			
Ungrounded	92	176	152
Dead-grounded	1,270	377	441
Resistance ground	225	292	248
Reactance ground	.....	100	100
Resistance factor K:			
Minimum	0.008	0.022	0.008
Average	1.04	0.52	0.80
Maximum	3.55	2.00	3.55
Maximum ground current:			
Minimum	425	102	102
Average	2,300	2,000	2,080
Maximum	4,620	5,950	5,950
Miles per ground:			
Dead ground	24	32	.....
Resistance ground	110	146	.....
Reactance ground	.....	100	.....
Total generating capacity	2,387,500	3,984,350	6,371,850

* Some companies operate both types of system.

Different types of resistance for the grounded neutral were considered, and the general conclusion was that on any large transmission system high-voltage strains are more to be feared than high-current strains.

A descriptive performance of the Petersen coils installed on the system of the Alabama Power Company was embodied in a paper on "The Neutral Grounding Reactor" by W. W. Lewis. This paper discussed the theoretical features surrounding the use of a reactor on ungrounded systems and gave the results of tests made on the installations in Alabama at the time the reactor was installed. The reactor used has no core, is oil-immersed, water-cooled and designed to operate continuously at 795 kva. with 55 deg. C. rise. The total loss in the reactor at full voltage and maximum current is about 21 kw.

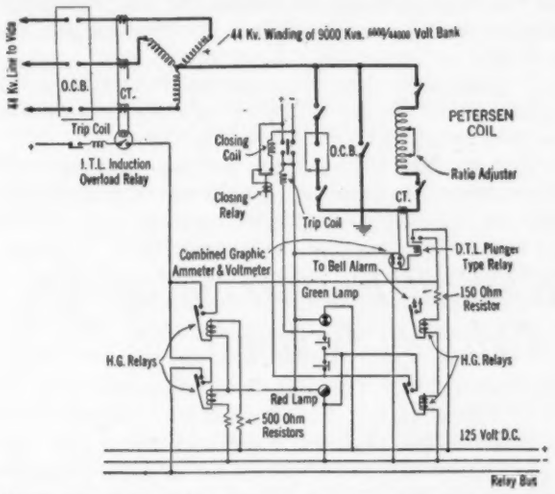
The resonance point of the circuit was determined in two ways—first, under normal conditions with no conductors grounded; second, when one conductor is grounded. Several series of arcing tests were made totaling about fifty arc-overs, and in this series of tests the arc was extinguished in from 5½ cycles to 14 cycles. Detailed data and oscillograms were made of the conditions under test which showed that the reactor functioned very well for the system upon which it was installed. Calculations showed that the current to ground when one conductor of a three-phase system is grounded is about one and a half times the normal three-phase charging current. Tests on the system showed that if the system had a ground wire the ground current was increased about 20 per cent. The arc-over test showed that the reactor would function to extinguish the arc with considerable tolerance in the setting. From the standpoint of voltage stresses the system with the reactor is more like an isolated neutral system than a grounded neutral system, except that the excessive voltage rises due to arcing grounds which occur on an isolated neutral system are eliminated. There is a possibility of overvoltage when the arc breaks, due to a difference between the resonant and supply frequencies, provided that the reactor serving is not in exact resonance. In the opinion of the author of the paper, the device will be limited to comparatively low-voltage lines of moderate length; that is, perhaps, up to 66,000 volts, or in a few cases up to 100,000 volts if the length of line is short. The reason given was that the current to the reactor is affected by the line reactance. Thus on long lines and high voltages it is probable that the residual current would maintain the arc. The author thought that the device appeared most applicable to those systems which are now operating isolated neutral and which for some reason connected with the operation or apparatus do not wish to go to a solidly grounded neutral.

PETERSEN COIL REDUCES INTERRUPTIONS DUE TO INSULATOR FLASHOVERS

According to a log of Petersen coil operation kept by the Alabama Power Company since Nov. 16, 1921, the Petersen coil has considerably reduced the number of interruptions due to insulator flashovers during lightning storms. This assertion was made by J. M. Oliver and W. W. Eberhardt in their paper on the subject. For example, during 1921, before the Petersen coil was installed, there were forty-three interruptions due to lightning, which caused the line to be out of service a total of 230 minutes. In 1922, when the Petersen coil was in service, there were only seven cases of interruptions due to lightning, or a reduction of 83.5 per cent, with the line out of service only fourteen minutes, or a reduction of 94 per cent.

However, the use of the Petersen coil is attended by

the disadvantage that the taps have to be changed for virtually every switching operation, so that the inductive reactance of the coil will always be in resonance with the capacity reactance of the line to ground. Furthermore, several bus insulator flashovers occurred



PETERSEN COIL CONNECTIONS (OLIVER AND EBERHARDT)

A definite-time-limit overcurrent relay is connected in the secondary of a current transformer the primary of which is in series with the Petersen coil and ground. This relay is given a time setting of approximately two seconds. Normally the flashovers are cleared by the Petersen coil in five to fifteen cycles; consequently, when an abnormal current persists for several seconds, it is evident that the reactor is not functioning. At the end of two seconds the relay will close, thereby energizing two auxiliary relays, one of which causes the grounding switch to close and the other to ring an alarm bell. The grounding switch on closing short-circuits the reactor and the regular overcurrent relay scheme comes into action to clear the trouble.

when line switching was performed while the Petersen coil was in service. Whether the coil was in any way responsible for the flashovers is not known, but as a precaution against similar trouble in the future, the line relay has been electrically interlocked with the control circuit of the grounding switch to insure that the latter shall be closed before the line switch can open on relay action. However, this has the disadvantage of slowing up the relay operation when clearing a short circuit.

During the period covered by the log there were 168 operations of the Petersen coil, of which only two could be strictly classed as faulty. In these two cases the flashover held on long enough to close the grounding switch and cause the overcurrent relays to open the line. The line went back into service properly in each case, indicating that the trouble was not a solid ground but a flashover which the Petersen coil evidently failed to clear. There was a total of twenty-nine cases of solid grounds and phase-to-phase short circuits due to line, transformer and bus trouble, which are outside of the operating sphere of the Petersen coil. However, all these were successfully cleared by the line relays. In three of these cases, however, after the line switch opened, a string of the five suspension insulators on the 44-kv. bus between the transformer and the line switch flashed over, indicating the presence of an unusually high voltage. Since the insulators tested satisfactorily, it seems that some high-voltage transient was introduced by the disconnection of the line capacitance. It is proposed to make further tests to verify this point.

In seven operations the grounding switch closed but no line switch opened and no disturbance occurred on the system. This action indicated a solid ground on the system, which evidently held on long enough (two seconds) to cause the definite-time-limit overcurrent relay to operate, but cleared before the contacts of the grounding switch closed.

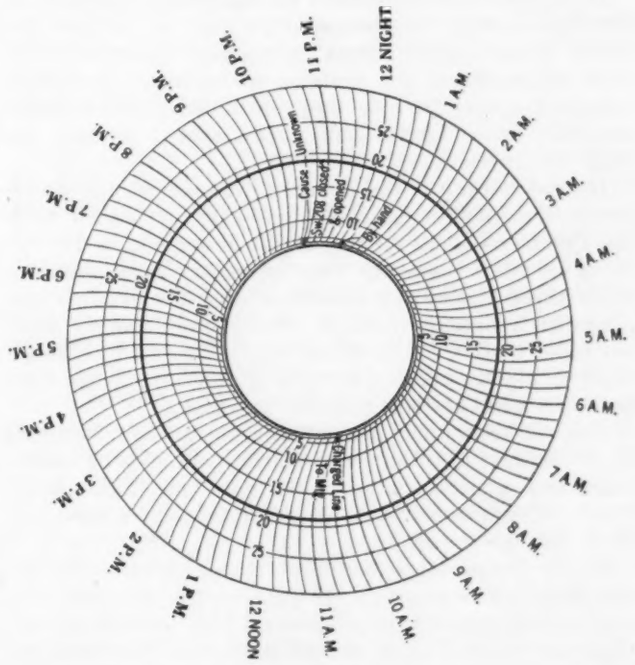
Twenty cases of reactor-current indications coincident with switching operations on the lines were observed when the neutral current must have been zero. These indications may have been due to the failure of all three poles of the oil-circuit breaker to open or close simultaneously, thereby causing a shift in the neutral.

While the experience of the Alabama Power Company indicates that the Petersen coil may prevent arcing grounds on grounded-phase operations, it is hardly safe to take the risk, as the imposition of full-line voltage to ground on the ungrounded phase for a considerable length of time will aggravate the trouble. With grounded-phase operation eliminated, the Petersen coil need have only a two-minute rating as compared with a continuous rating and would be less costly.

Other points which the experiences recited brought out were that all insulator pins should be grounded in order to insure the best positive action of the coil; that all switching, both hand and automatic, should be done with the Petersen coil out of service—viz., with the neutral solidly grounded—and that grounded phase operation is not advisable.

Considerable discussion arose at the Tuesday afternoon session regarding the relative merits of low and high resistance grounds, some advocating low resistance to secure enough current to operate selective relays and others favoring higher resistance to minimize disturbances. It appeared to be the consensus of opinion that the Petersen coil is limited to short branch lines.

Different problems are involved in grounding cables and overhead lines. R. W. Atkinson pointed out that it is feasible to insulate overhead lines for overvoltage,



GRAPHIC RECORD OF COIL OPERATIONS (OLIVER AND EBERHARDT)

but hardly so with cables. Furthermore, cable has greater electrostatic capacity than open wires. As indicating the success of the solidly grounded neutral, Mr. Atkinson referred to a 33,000-volt cable installation in Los Angeles which has operated two years.

F. C. Hanker pointed out that the Montana Power

Company reversed several years ago its opinion that the size of a grounded neutral system is limited. From the evidence presented it is very apparent, said Mr. Hanker, that the use of the Petersen coil is very limited.

The great diversity of opinion on grounding was dwelt upon by J. B. Taylor. In some cases large currents are allowed to avoid voltage surges, and sometimes vice versa. Besides, there are differences of opinion on the value of resistance to use. There is no virtue, he contended, in clearing a fault by allowing a great rush of current just because the equipment will withstand it. Such practice may in time weaken parts of the system. The most important factor in grounding is the calculation of the resistance; this should depend on the switch settings.

L. P. Ferris called attention to factors which should have serious consideration in grounding. For example, triple harmonics occur in grounded neutral systems which may disturb adjacent telephone lines. The possible bad effect of multiple grounds was also emphasized. Y-Y connections are very undesirable, but fortunately their number is limited. Mr. Ferris said that it is very gratifying to notice that the Petersen coil reduces interruptions, since otherwise the short-circuit currents developing from faults would produce acoustic shocks. Such shocks could be reduced still more if a resistance were connected in series with the breaker which is used to short-circuit the Petersen coil when it fails to function. The current experienced when the Petersen coil is set for resonance, he explained, is apparently due to the unbalanced voltage resulting from unbalanced arrangement of lines to ground. This condition can be corrected by balancing from neutral to lines.

H. W. Smith recommended rating ground resistors at 600 deg. since at this temperature they would have the safety factor which comes from change of resistance with temperature. As systems operating at generator voltage increase in size they must come to grounded neutrals, he contended, and hence should be laid out with this in view.

In explanation of the apparent voltage surges which occur when switching operations are carried on with the Petersen coil in circuit, H. M. Trueblood said: "If there is more reactance than necessary for resonance when three phases are connected, and if by chance one phase of a breaker fails to open simultaneously with the other phases, then voltage surges will occur. Hence care should be taken not to have more reactance connected in the Petersen coil than necessary."

The problem when using the Petersen coil, declared H. H. Dewey, is to secure the proper balance of inductance and capacitance, particularly on long high-voltage lines. Hence the Petersen coil is chiefly adapted to short branch-circuit lines.

R. D. Evans contended that the application of the Petersen coil is reaching its limit on the Alabama system, according to the data obtained. He warned against changing from a free neutral system to Petersen-coil protection without providing for the conditions imposed by grounded neutral operation.

There is more necessity of grounding frequently on high-voltage lines than on others, maintained C. L. Fortescue. Grounding reduces the cost of transformers, he explained.

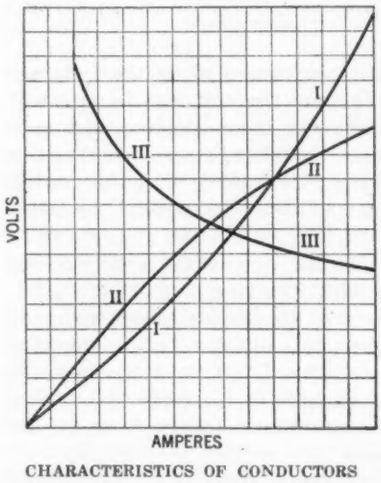
No one system of grounding is suitable for all conditions, J. Allen Johnson pointed out. Power lines with greatest exposures must use higher ground resistance to minimize interference. With induction-type selective relays, he explained, one cannot rely on their current settings as much as on their time characteristic when grounds occur. Just because a system can withstand short circuits is no reason for subjecting it to them in order to clear grounds. For protection against such faults he advocated ground relays.

L. F. Blum advocated transposing transmission lines, reducing power losses in Petersen coils and detuning to get the best protection from this system.

In closing, Mr. Dewey cited several examples where multiple grounds have not produced serious disturbances.

Technical Features of Surges and Arcing Grounds

Dr. Charles P. Steinmetz, in a paper entitled "Frequency Conversion by Third-Class Conductors and Mechanism of the Arcing Ground and Other Cumulative Surges," discussed the building up of high-voltage oscillations in power circuits which differ from the typical transients of energy readjustments in that they do not gradually die out but increase in intensity until either destruction occurs or they finally limit themselves. These surges, of which the arcing ground is typical, derive their energy from the machine power of the system and so constitute a frequency transformation of which the mechanism has been little understood. Dr. Steinmetz derived the equations of the circuits of this character on the basis of a physical conception which considers a negative resistance in combination with the source of power which supplies the energy given out by the negative resistance. The so-called "third-class conductors" are those in which the voltage decreases with the increase of current, and the author showed that these conductors can be considered as a combination of the negative resistance with a source of power and as such are capable of transforming the low circuit frequency into a high oscillation frequency of alternating current. Their presence in an electric system may in this way produce cumulative oscillations.



CHARACTERISTICS OF CONDUCTORS

I—Metallic conductors. II—Electrolytic conductors. III—Disks as conductors. (Steinmetz.)

The general equations in the paper were based on a system comprising a third-class conductor shunted by an inductive circuit containing capacity and supplied with voltage over an inductive circuit from an alternating low-frequency source, and the author showed that in such a system current and voltages of two distinct frequencies may continuously exist, of which one is the fundamental circuit frequency and the other a high oscillation frequency. The voltage at the high oscil-

lation frequency is limited only by the resistance of the oscillating circuit and may build up to very high values, particularly in the transformer. Thus the cumulative surge of the arcing ground in a transmission line does not reach such excessive values as that in the high-voltage coil of the power transformer, but may be of moderate intensity of the magnitude of the normal line voltage.

EXPERIMENTAL OBSERVATIONS DETERMINE THEORY OF ARCING GROUNDS

Pointing out that the primary reason for operating transmission systems with a grounded neutral is to alleviate the destructive effects produced by arcing grounds, J. F. Peters and J. Slepian presented a paper on the arcing ground and the theory underlying its operation. The paper is based on laboratory experiments which duplicate arcing grounds. These elaborate experiments substantiate the theory which, when applied to a three-phase system, calls for displacement of neutral relative to ground and the development as a result of transient oscillations of maximum voltage three and one-half times normal voltage to neutral on the sound phases and two times normal voltage to neutral in the grounded phase. In a grounded neutral system with low impedance between neutral and ground the charge will be drained off before the next arc strikes and the maximum voltage which will be developed will be two and one-half times normal and one times normal at the same points stated previously. Thus the maximum voltages developed by arcing grounds on isolated neutral and grounded neutral systems respectively are in the ratio of three and one-half to two and one-half. This does not consider, however, the effect of sudden changes of voltage distribution in the interior of apparatus connected to a system in which the effect is much greater in the isolated neutral system. Thus the surges set up by the arcing grounds must be considered as a source of danger to the connected equipment.

Dr. J. Slepian, in the discussion of arcing grounds, took exception to the mathematical treatment of the arc and its negative resistance properties in Dr. Steinmetz's paper, saying that there was a lack of definite mathematical statement of the nature of the arc which made it necessary to go through the mathematical treatment and pick out the assumption. He said that the assumption for low-frequency arcs seems to be on the basis of straight-line characteristics, while for the high-frequency arcs a time lag assumption is brought in that gives the characteristic curve as an ellipse. With these deductions from the paper, Dr. Slepian questioned the reasonableness of the figures in the practical examples assumed by Dr. Steinmetz, saying that the negative resistance figures were too high. In place of the assumed value of 120 ohms he gave 20 ohms as a more reasonable assumption for the value of negative resistance. He claimed that the value used gave results that are impossible in any arc encountered in practical experience.

E. E. F. Creighton, using the analogy of a violin string, pointed out that many arcs over insulators or from conductors to ground might occur without serious consequences, but that an arc from a point on a line where the frequency of the disturbance corresponds with the natural frequency of the line or some piece of apparatus might cause a large amount of damage. He went on to illustrate by citing an example of a furnace installation that had operated successfully and had been enlarged by the addition of three transformers to the original three. It was then found impossible to keep all six transformers in service, owing, as was later discovered, to resonance between the frequency in the arc and the natural frequency of the transformer coils which resulted in small arcs forming between turns and ultimate serious breakdowns. Mr. Creighton also gave as the reason why the arcing ground suppressor had not proved successful, and why the Petersen coil would not, the close adjustment required of the apparatus to system conditions to enable either of them to function successfully. So close is this adjustment that it is impracticable to keep such devices adjusted to momentary changes in system conditions.

W. A. Hildebrand asserted that the voltage factor is not fundamental and that the high-frequency factor, which has no relation to 60-cycle characteristics, has been largely overlooked in the studies of arcing grounds.

C. L. Fortescue said that Dr. Steinmetz's ideas should be carried out to give more plausible values and that the papers presented show the need of more study, not under laboratory conditions but on a large scale.

H. R. Woodrow, in discussing the paper of Messrs. Peters and Slepian, said that maximum potentials were given but that system absorption had been neglected. Normally, he said, smaller values, particularly on underground cables, would be experienced.

That the figures of experts could not be checked by the experience of a Georgia company was asserted by E. P. Peck, and that one line 65 miles long operating at 60 kv. had developed surge voltages over 180 kv. was certain. The trouble had been cured by grounding the neutral through good grounds. Lately the same class of troubles have been cured on a Utica (N. Y.) property by solidly grounding the generator neutral.

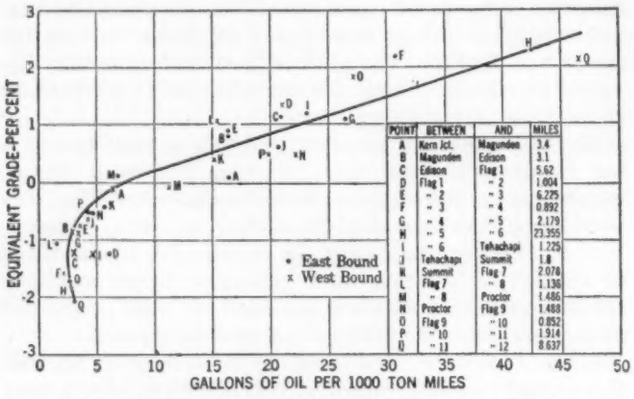
Furnace Operation and Electrification

Test data on a representative mountain railway on the West Coast showing the fuel consumption of an average mountain-type locomotive burning oil were presented by A. H. Babcock in his paper on "Some Fuel Determinations on the Southern Pacific System." The paper contained a complete record of fuel consumption, beginning with firing up at the engine house and the standby consumption while the engine is waiting outside the house for the train, and including consumption while testing brakes, during acceleration, running up and down the various grades, holding the trains on sidings and finally running down hill over stretches of steep grade.

The over-all efficiency determined by the test was 5.57 per cent. It is the ratio of the integrated foot-pounds of work done by the engine whenever the drawbar pull was positive to the total energy in the fuel used over the same time. From the test it is apparently constant for all grades greater than 0.5 per cent. The average operating efficiency rated on eastbound and westbound travel was 92.5 per cent, with an average thermal efficiency of less than 6 per cent. The ratio of the revenue freight weight to total train weight was 0.743, and in making comparisons this factor must be considered. The resultant data apply, in the opinion of the author, to the specific conditions, and should not be applied indiscriminately to all conditions of operation.

Dr. Cary T. Hutchinson, in an analytical discussion,

pointed out that Mr. Babcock's analysis was not general in scope but limited to the determination of the oil used on the particular section of the Southern Pacific under the conditions of service ruling there. Furthermore, no drawbar-pull measurements were made, so that figurges for efficiency were based on calculations of work done from the profile of the section under the specific assumptions of the author.


EQUIVALENT GRADE-PER CENT
GALLONS OF OIL PER 1000 TON MILES
• East Bound
x West Bound
POINT | BETWEEN | AND | MILES
A | Kern Jct. | Magunden | 3.4
B | Magunden | Edison | 3.1
C | Edison | Flag 1 | 5.62
D | Flag 1 | " 2 | 1.004
E | " 2 | " 3 | 6.275
F | " 3 | " 4 | 0.892
G | " 4 | " 5 | 2.179
H | " 5 | " 6 | 23.355
I | " 6 | Tehachapi | 1.225
J | Tehachapi | Summit | 1.8
K | Summit | Flag 7 | 2.078
L | Flag 7 | " 8 | 1.136
M | " 8 | Proctor | 1.486
N | Proctor | Flag 9 | 1.488
O | Flag 9 | " 10 | 0.852
P | " 10 | " 11 | 1.914
Q | " 11 | " 12 | 8.637

FUEL CONSUMED PER 1,000 TON-MILES ON VARIOUS GRADES (BABCOCK)

Mr. Hutchinson then assumed to replace the steam locomotive with a four-axle, 110-ton electric locomotive for a 750-ton trailing weight and assumed an efficiency from power house to locomotive drivers of 63 per cent and then calculated the comparison between steam and electric operation, arriving at results given in Table I.

TABLE I—WORK DONE AT DRIVERS, STEAM DRIVE

	—Eastbound—		—Westbound—	
1. Weight of train, tons	.....	1,000	...	1,000
2. Work at drivers, kw.-hr.:				
(a) Grade	2,760		985	
(b) Curve	250		25	
(c) Track	690	3,700	240	1,250
3. Available for regeneration, (a) — (b+c)		1,820		720
4. Delivered to contact system, 75 per cent		1,365		540
5. Deliverable at driver, 80 per cent		1,090		430
6. At driver as per cent of total work		29.4		34.4
7. Same, for round trip, same tonnage both ways		30.6		

He then assumed that 30 per cent of the total requirement is furnished by gravity and 70 per cent by power station, and concluded that the relative energy requirements for a round trip are as shown in Table II.

TABLE II—RELATIVE HEAT REQUIREMENTS, STEAM AND ELECTRIC, FOR SAME SERVICE

	Steam	Electric
1. Weight of train, tons	1,000	860
2. Energy at driver, total kw.-hr	4,950	4,250
3. Energy at driver, from oil, kw.-hr	4,950	2,970
4. Energy at driver, from oil, per cent	100	60
5. Heat required at drawbar per kw.-hr., B.t.u	109,000	45,500
6. Total heat required, (10^6xB.t.u.)	540	135
7. Total heat required, per cent	100	25

Mr. Hutchinson then concluded as follows:

"This means that, in comparison with the author's test result, electric drive would reduce the fuel required by 75 per cent—a ratio of steam to electric of four. If allowance be made for the difference between tests and service conditions, this ratio will be even greater. These results are in practical agreement with the estimates of the superpower report."

N. W. Storer said that 7 lb. per ton was too high a train resistance for a whole run, so the work calculated was more than would be the case. He also questioned the accuracy of determination of locomotive resistance.

W. J. Davis pointed out that the results were better than could be expected from a coal-fired locomotive, stating that the cinder loss varied from 10 to 18 per cent in coal-fired locomotives with the rate of coal burning varying from 100 lb. per square foot per hour to 125 lb. per square foot per hour.

Mr. Davis' principal point was that, even though there were fuel savings, the fixed charges of electrification might easily offset them, but that the chief reason for electrification still existed in the advantages in conducting transportation. He cited increased capacity of tracks, reduction of overtime, very great savings in locomotive repairs per locomotive and reduction of number of locomotives—because the average steam locomotive was available for service only 25 per cent of the time, whereas the average electric locomotive was available 95 per cent. Mr. Davis concluded that because of greater serviceability and because electric locomotives could be made larger, one electric might actually replace four to five steam locomotives. Thus, said Mr. Davis, even with the fuel saving counterbalanced by fixed charges, by the saving in maintenance of locomotives, in maintenance of ways and structures and in wages total transportation economies of 25 to 50 per cent might be realized.

Mr. Twogood, in replying for Mr. Babcock, said that they had tried all sorts of mathematical analyses and could come to no other conclusion than the one given. He admitted that fuel was not the determining factor. He pointed out that operating officials were interested in the weight of the locomotive as well as of the train because eventually it was net revenue freight which paid the bill.

Through a large number of observations the author of the paper on "Some Problems in Electric Furnace Operation"—F. V. Andreae, chief engineer Southern Manganese Corporation—was led to believe that the transformation of electrical energy into heat energy in the furnace takes place in an arc passing through an atmosphere of vapors under pressure. The properties of the arc vary with the different materials. The current will increase when the arc is shortened under constant voltage and for constant currents, and the voltage

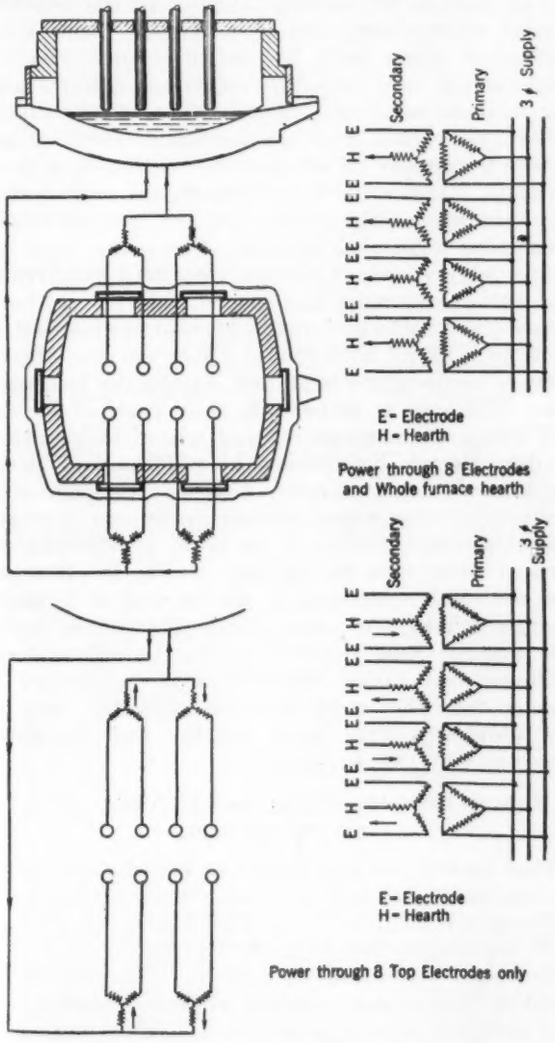
THEORETICAL ELECTRICAL CONDITIONS IN ELECTRODE LEADS OF VARIOUS TYPES FOR 4,000 KV-A. ELECTRIC FURNACE

Electrical Propedies									Remarks Relative to Property
Size	24-4-1 per Phase Straps or Contact	24-4-1 per Phase Brass Screen	72-4-½ Tube Interlaced	2.5" Tubes per Phase	3-4½" Tubes per Phase	3-4½" Tubes per Phase	4-3" Tubes Interlaced	4-3" Tubes Interlaced	
Remarks Rel. Type	Middle Phase	Middle Phase	Phases Balanced	Middle Phase	Middle Phase	Phases Balanced	Phases Balanced	Phases Balanced	When unbalanced
D.C. Resistance	0.000,027.1 Ω	0.000,027	0.000,027.1	0.000,026.6	0.000,024.3	0.000,024.3	0.000,026.9	0.000,026.9 Ω	Phase 1 R 0.000,549 Ω
$\frac{X_L}{R}$	2.18	2.01	2.01	1.13	1.09	1.09	1.02	1.02	Phase 2 R Ω
A.C. Resistance	0.000,060 Ω	0.000,054.2	0.000,054.2	0.000,030.1	0.000,026.5	0.000,026.5	0.000,027.5	0.000,027.5 Ω	Phase 3 R 0.000,548 Ω
Inductance	0.000,013.8 H	0.000,012.4	0.000,001.3	0.000,013.4	0.000,012.3	0.000,012.3			Phase 1 X_L 0.000,318 Ω
Ind. Reactance	0.005,20 Ω	0.005,060	0.000,490	0.005,060	0.004,65	0.004,65			Phase 2 X_L Ω
									Phase 3 X_L 0.000,318 Ω
IR Drop	0.59 V.	0.54	0.54	0.30	0.27	0.27	0.275	0.275 V.	
IX_L Drop	52.0 V.	51.0	4.9	51.0	47.0	47.0	26.4	24.7 V.	
% IR Drop	0.465 %	0.426	0.426	0.237	0.208	0.208	0.217	0.217 %	
% IX_L Drop	41.0 %	39.8	3.85	39.8	36.5	36.5	20.8	19.5 %	at Unity Power Factor
% Volts Loss	8.5 %	8.0 %	0.6 %	7.8 %	6.5 %	6.5 %	2.3 %	2.0 %	Total Volts Lost
Watts Line Loss	3 x 5900 W.	3 x 5400	3 x 5400	3 x 3000	3 x 2700	3 x 2700	3 x 2750	3 x 2750 W.	on basis of $\frac{3E}{\sqrt{3}}$ V. In
% Watts Loss	0.44 %	0.41 %	0.41 %	0.23 %	0.20 %	0.20 %	0.206 %	0.206 %	neutral
DATA									
No. Electrodes 3 - Y-Connected, both is neutral									
Transformer 1-3 Phase, Y Connected									
Primary Voltage 22,000									
Secondary Voltage 220									
Amperes per Phase 10,000									
Kv-a. Rating 4,000									
Current Density in Electrode Leads 800 Amp. per ▫"									
Frequency = 60 ~ Values calculated for Conductors 20 Ft. Long Each									

ANALYSIS OF ELECTRODE LEAD PERFORMANCE (SAKLATWALLA AND ANDERSON)

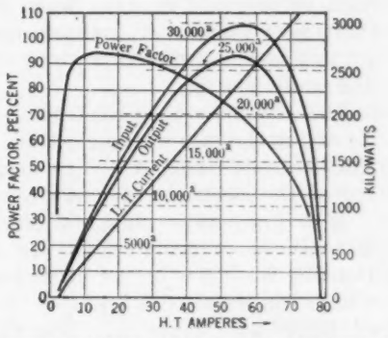
across the arc will increase with increasing length. Based on the theory that the reactance of a three-phase electric furnace does not depend on the load, but does depend on the arrangement of the conductors, the author derived a general equation for the furnace. He showed that, owing to the fact that the main conductors carrying the current from the interlaced busbars to the furnace are more or less in one plane, a transformer action is introduced between phase 1 and phase 3, taking power away from phase 1 and transporting it to phase 3, the phase rotation being 1 to 3. This power may be considerable. Moreover, when voltages between phases and currents are balanced the power delivered by the three electrodes is quite unbalanced, a fact that is very apparent in large furnaces, electrode 1 seeming dead while electrode 3 takes most of the power.

The load in the furnace is considered as connected in star, the bottom of the furnace being the neutral. The electrical energy is transformed into heat energy in three separate zones, situated under the three electrodes, and the load resistance is probably furnished by an arc in an atmosphere of the vapors under pressure. The author took up specific examples of the application of the general equation and showed how the unbalance can be taken care of in several ways. He reached the conclusion that the general performance of the three-phase furnace can be determined in advance with a large degree of accuracy by using the simple equations of the balanced three-phase system, where the only thing that is necessary is the previously determined reactance per phase, which is an important characteristic of the furnace.



60-TON TO 80-TON FURNACE DESIGNED FOR FORD MOTOR COMPANY (HODSON)

Electrical factors to be considered in the design of leads for ferro-alloy electric furnaces in order to achieve the highest input efficiency were discussed in the paper by B. D. Saklatwalla and A. N. Anderson. They also described a new system of electrode control which consists of Kelvin balance actuating relays which in turn control the operation and direction of rotation of the motors operating the electrodes. Information was also given on a new electrode holder to curtail the time of making changes.



PERFORMANCE CHARACTERISTICS FROM CIRCLE DIAGRAM (ANDREAE)

The authors reached the following conclusions:

1. The larger the cross-section of the conductor the larger the skin effect. This effect is appreciable at frequencies of 60 cycles for conductors greater than ½-in. diameter.

2. Skin effect is higher in straps than in tubes of equisectional area with subsequent higher power loss.

3. Distribution of the current over the sectional area is not affected by the inductive disposition of the conductor, since the internal inductance is unaffected by the mutual inductances.

4. Inductive reactance may cause considerable voltage drop in the electrode leads.

5. The larger the diameter of the conductors the less the inductance.

6. The farther apart the conductors the larger the inductance.

7. When inductive reactance expressed as per cent reactance drop amounts to 20 per cent or more, the actual volts drop in the line increases rapidly with decreased power factor.

The nearest approach to the tubular form of conductor for flexible leads is the familiar asbestos-cored extra-flexible cable developed expressly for furnace operation.

The development of the large electric melting furnace, the limitations of large electrode furnaces and the design and construction of the largest electric melting furnace ever built were subjects covered in a paper by Frank Hodson. He also discussed the advantages of correct heat application, the influence of the new Soderberg continuous electrode on furnace design and the possibility of using large electric furnaces as an intermediate process for the manufacture of cheap steel.

The Greaves-Etchells furnace as finally developed may be described as an arc-resistance furnace which on normal operation introduces two phases of the three-phase power supply through two or more top electrodes and the third phase through the whole of the furnace

hearth. On all recently installed furnaces of this type with four or more electrodes the system and design permit of the whole of the power being derived through the top electrodes or by change of position of an oil switch through the top electrodes and the furnace hearth, a balanced load being obtained with either method. This arrangement gives the furnace considerable flexibility of operation, as the top electrodes and high voltage can be used when melting down or when starting up the cold furnace, and the top and bottom contacts when a molten bath is obtained or for refining and superheating.

The new Soderberg electrode consists of a thin metallic casing the size of the electrode to be used, into which the electrode paste or mix is dropped. The actual baking of the electrode is done in the furnace.

A diagrammatic plan and elevation of the 60-ton to 80-ton furnace designed for the Ford Motor Company, Detroit, is shown in the accompanying illustration. It will be equipped with eight electrodes and transformers of 12,000-kva. capacity. The electrodes are arranged in two rows of four, and each pair and contact plate under the hearth of the furnace, which is common to all, form an electrical unit and are supplied by a 3,000-kva., three-phase transformer. By means of a switch power can, if desired, be derived entirely through the top electrodes. When this is done the bottom connections are thrown in series, and consequently no current can flow through the hearth.

Furnaces Used in Making Alloys

The assertions regarding the sizes of arc furnaces in Frank Hodson's paper were questioned by W. E. Moore, who said that there was no reason why other types of arc furnaces should not be made in larger than 40-ton sizes. He characterized the ideal furnace as a one-electrode, single-phase type, but said that the power companies would not tolerate such a furnace. He said that 24-in. electrodes are not the largest available, as at least 32-in. electrodes are in use and 36-in. are made for the Soderberg type. Both Mr. Moore and F. W. Brooks criticised Mr. Hodson's advocacy of the conductive bottom, asserting that it is a weakness in furnace design. Mr. Brooks said that acid bottoms will not conduct current at voltages used in steel furnaces and that conductive bottoms can therefore be of basic material only, and these will not stand up under the heat involved. Mr. Moore questioned Mr. Hodson's statements regarding balance, stating that the variable resistance of the conductive bottom produces unbalance. He also characterized Mr. Hodson's statements regarding distributed heat as having a backward tendency, because it is necessary to keep electrodes as far away from the furnace refractory linings as possible in order to keep down temperatures.

E. T. Moore said that F. V. Andreae's paper had given undue attention to balanced loads between conductors and other parts of the apparatus and that the determining factor is the distance of the electrodes above the bath. Fluctuations, rather than load unbalances, he said, were detrimental to the central station. He also said that the Kelvin balance method described by Messrs. Saklatwalla and Anderson was not necessary in all types of furnaces. To this and a point about the effect of charging on load balance raised in the discussion Mr. Saklatwalla replied by outlining the continuous and uniform method of charging with finely divided and well-mixed material employed in the ferro-alloy processes in which the furnace is used. This, he said, made the wattage-input control method superior to voltage and amperage control. E. T. Moore took issue with the assertions of Mr. Hodson about the induction furnaces, expressing the opinion that with the advance of the art and availability of low-frequency current small induction furnaces have been developed and successfully used and large ones are within the realms of possibility.

Heating a Cotton Weave Shed by Electricity

Electricity is used exclusively for heating the St. Croix mill of the Canadian Cottons Company, Ltd., Milltown, New Brunswick, Canada, which operates 56,880 spindles and 1,448 looms. The equipment used for heating this mill was described in a paper by C. T. Guildford, who also outlined the calculations made to estimate the quantity of heat required for buildings of this kind. Computations were presented to show the conditions under which electric heating in a textile mill may be used.

The method of heating adopted is the Sturtevant hot-air system with groups of electric heating units instead of steam coils in the fan room. The weave shed, which is a one-story building, 480 ft. long x 182 ft. wide, requires 1,600 kw. consumption at 15 deg. below zero, which with the equipment installed leaves a reserve capacity of 463 kw. for further drop in temperature. According to tests made, the room temperature can be quickly brought to any desired value by connecting additional heaters. The actual heat input checks very closely with the calculated requirements. The author concludes that electric heat should be purchased at an estimated cost of $0.0025 per kilowatt-hour to be on a parity with coal at $10.50 per ton where the average temperature is 22 deg. during the heating season. With coal at $5 per ton, as in parts of the South and where the average heating season temperature is 48 deg., electric heat should be purchased at $0.00156 per kilowatt-hour. Electric heat may be adopted with economy in mills where surplus hydro-electric power is available. In the case of the plant at Milltown a return of more than 37 per cent on the investment for the electrical equipment is shown, and in a plant in Georgia a return of over 18 per cent can be realized. The average heat required during the night for the Milltown installation was found to be 44 per cent greater than that required during the day, even after due allowances were made for the heat supplied by power and by the operators.

Should Compare Steam and Electric Heating on Proper Basis

That electric and steam-heating systems are not comparable on the basis of heat units furnished for heating purposes was the opinion of Wirt S. Scott in discussing C. T. Guildford's paper on electric heating of a cotton-weave shed. He said that 50 per cent of the heat supplied from a steam-heating system is conducted out of a building because of the location of radiators near windows or similar openings. In the case discussed in the paper Mr. Scott said that for steam heat a change in air of four times per hour had been figured, while for electric heat only once in two hours had been provided for. He emphasized the importance of heat given off by motors and other power equipment in considering such a heating problem. In the case of the Canadian plant this amounts to 600 hp. in motors. During

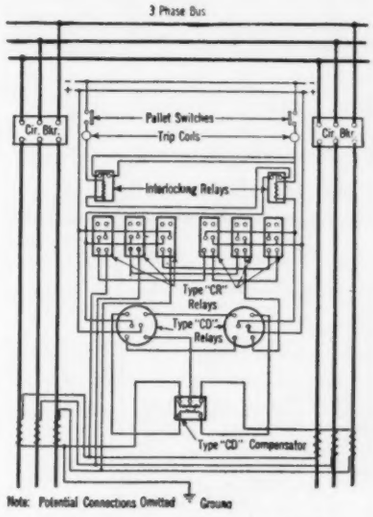
cold winter nights, with no motors running and with outside temperatures 20 deg. below zero, he said that the sixteen heating circuits with a capacity of 2,200 kw. may be required to keep the rooms at 70 deg. During the day, with somewhat higher temperatures outside, six of the main heating circuits usually keep up the room temperature. An adjustment of the automatic control of one circuit with a capacity of 137½ kw. usually suffices to keep the room temperatures within one degree of the 70 deg. for which the control is set, according to Mr. Scott.

New Relay Schemes and Illumination

Relays and their operation formed the major subject treated in the technical session held Wednesday afternoon, at which N. W. Storer presided. The papers presented gave examples of recent relay practices, and a remarkable unanimity of opinion existed on the relay methods best suited for different systems.

The Duquesne Light Company has recently installed a new relay system on the 66-kv. ring surrounding Pittsburgh. H. P. Sleeper described the method of relaying employed and the results of tests made on the installation. The ring is made of parallel lines and is sectionalized at seven points, two of which are generating stations. The greater part of the load is industrial-motor and synchronous converters. A number of relay schemes were investigated, and a scheme using balanced directional relays for short-circuit protection and selective differential current relays for ground protection was chosen.

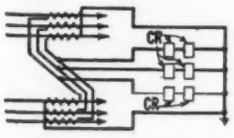
The short-circuit relays are of the CR type and the ground relays are rated at ⅓ amp. Interlocking relays are installed in the trip circuits of both lines to render the good line non-automatic for a few seconds after the relays have tripped out at one end of the defective line. This locks out the trip circuit of the good line until the relays at the opposite end of the section have had time to clear the line in trouble. On standard sections these relays are set at 0.4 second definite time. One 63-ohm, grounding resistor is used at each generating station, and the ground relays close contacts in 0.3 second. If the



CONNECTIONS OF BALANCE SCHEME USED (SLEEPER)

SCHEME NO. 1
Balanced Reverse Power Protection Only

Schematic Connections



ADVANTAGES

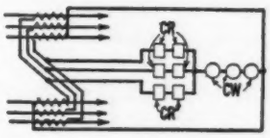
1. Simplicity of wiring and equipment.
2. Directional single-line protection afforded.
3. No additional relays required for ground protection.
4. Requires dead grounded neutral.

DISADVANTAGES

1. Imposes severe voltage unbalance on line which will effect synchronous machines.
2. Severe damage may result as heavy ground current must pass to operate relays.

SCHEME NO. 2
Balanced Reverse Power Protection for Short Circuits and Watt Relay Protection for Grounds

Schematic Connections



ADVANTAGES

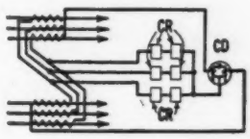
1. Satisfied all conditions for short-circuit protection for both parallel and single-line operation.
2. Small ground current may be used which ensures the elimination of voltage disturbances.

DISADVANTAGES

1. Additional relays necessary for ground protection, at least one per circuit being required.
2. Wiring is complicated.
3. Extra grounding potential transformer required for one scheme using the watt ground relay.
4. Another scheme used three double contacting watt relays per pair of lines but this scheme does not have a dependable selectivity.

SCHEME NO. 3
Balanced Reverse Power Protection for Short Circuits and Balanced Current Relay Protection for Grounds

Schematic Connections



ADVANTAGES

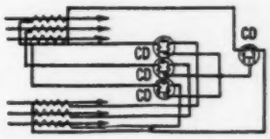
1. Wiring and equipment simple, only one set of relays being required for ground protection of two parallel lines.
2. Satisfies all short-circuit conditions, for both parallel and single-line operation.
3. Small ground current required to operate ground relays.
4. Ground relays very positive in action.

DISADVANTAGES

1. Ground protection is inoperative when ring is open.
2. Ground relays are non-directional for single-line operation.

SCHEME NO. 4
Balanced Current Relays for both Short Circuit and Ground Faults

Schematic Connections



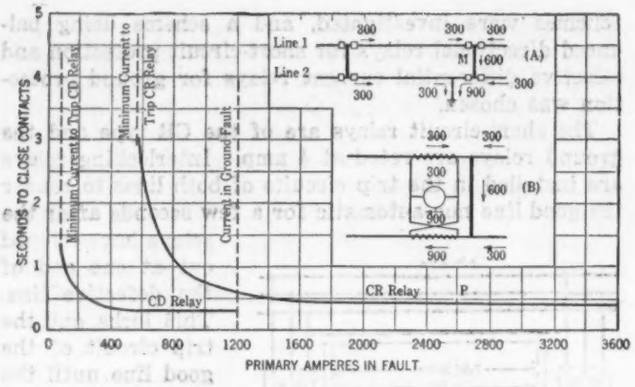
ADVANTAGES

1. Simple wiring and equipment.
2. Only one ground relay required for ground protection of two parallel lines.
3. No potential connections required.
4. Ground relays very positive in action.

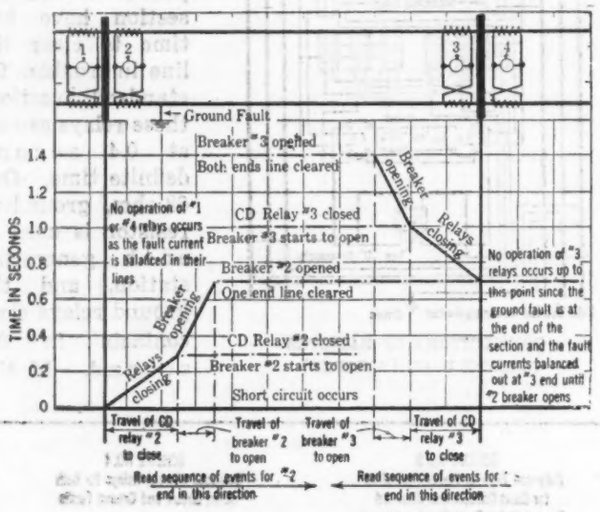
DISADVANTAGES

1. Neither short circuit nor ground protection is operative if ring is open.
2. Single-line operation is not directionally selective.

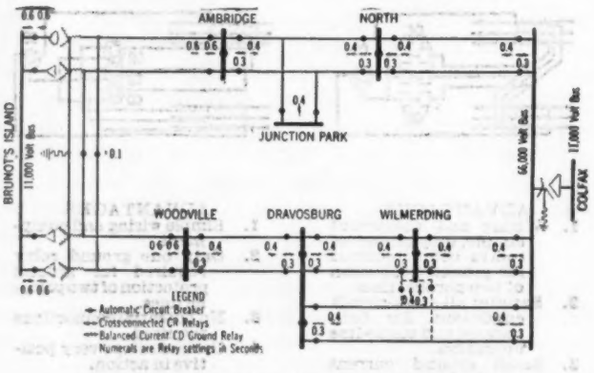
SEVERAL BALANCE SCHEMES WERE COMPARED AND NO. 3 CHOSEN (SLEEPER)



SETTINGS FOR SHORT-CIRCUIT AND GROUND RELAYS (SLEEPER)


TIME IN SECONDS
Ground Fault
Breaker #3 opened
Both ends line cleared
No operation of #1 or #4 relays occurs as the fault current is balanced in their lines
CD Relay #3 closed
Breaker #3 starts to open
Breaker #2 opened
One end line cleared
CD Relay #2 closed
Breaker #2 starts to open
Short circuit occurs
Breaker opening
Relays closing
No operation of #3 relays occurs up to this point since the ground fault is at the end of the section and the fault currents balanced out at #3 end until #2 breaker opens
Travel of CD relay #2 to close
Travel of breaker #2 to open
Travel of breaker #3 to open
Travel of CD relay #3 to close
Read sequence of events for #2 end in this direction
Read sequence of events for #3 end in this direction

TIME CURVES OF RELAY PERFORMANCE (SLEEPER)

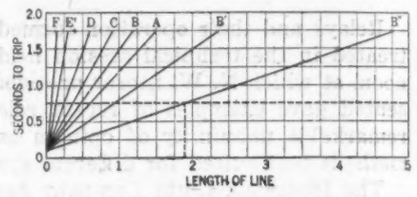


SYSTEM RELAY LAYOUT AND SETTINGS (SLEEPER)

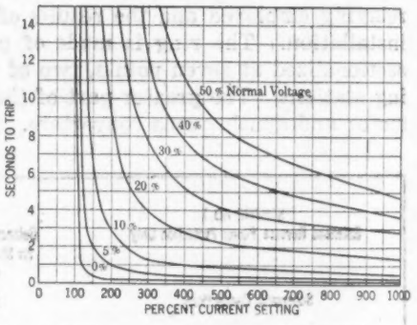
ground relays fail to respond to the ground fault, the grounding resistors are short-circuited after a period of ten seconds. This places a dead ground on the system and puts the short-circuit current in the CD relays, which causes them to operate.

A series of dead grounds were put on the ring to test the relaying. The dead ground was then replaced by a resistance ground, and that in turn by an arcing ground. A total of twenty-eight grounds was put on the system without damage, and the resultant relay operation was satisfactory.

A new device for accurately isolating trouble was described in a paper entitled "The Distance Relay for Automatically Sectionalizing Electrical Network," by Leslie N. Crichton. In determining the distance the relay makes use of the balance principle and bases its calculations upon the value of current and voltage existing at the time of the short circuit. In principle the relay has a current coil arranged to close contacts, while a voltage coil is so arranged that as long as voltage is applied it will tend to overpower the current coil and prevent the contacts from closing. The two coils are adjusted so that on a section of line the current coil will just overpower the voltage coil when a short circuit occurs at the far end of the section. The relay is so designed that when the trouble is close it will operate instantaneously, but when the trouble is some distance away it will operate slowly, so as to allow any relay which is nearer to the trouble to act. The induction-type relay has a disk which is rotated by the current coil whenever the current reaches sufficient magnitude, the movement of the disk being damped by the permanent magnet so that its speed is proportional to the current. The movement of this disk does not directly close the contacts, but instead it tightens a spiral spring. On the other end of this spring is fastened a lever which is pivoted at the center and which has the contacts on one end and the core of the voltage coil on the other. This voltage coil is so arranged that it opposes the closing of the contacts. When in the neutral position all parts of the relay are balanced, so that if there is no voltage on the voltage coil a very slight movement of the disk will close the contacts. Similarly, if the voltage is applied to the restraining coil, its unbalance will prevent the contacts from being closed until the spring has been tightened up sufficiently to overcome this, and since the motion of the disk is damped, this will require some time. The voltage coil will discriminate quite positively between zero voltage and 5 per cent of normal voltage. In addition to the distance-determining element, the relay has a directional element in order to locate definitely the direction of the trouble as well as its distance away. The directional contacts are in series with the distance contacts and act as a sort of check valve to prevent the relay from operating when power is flowing toward the busbars. The author claims for the relay that all dead short circuit will be cleared within one second and the majority of them in considerably less time, and trouble will be cleared with equal rapidity from all parts of the system. In effect, the well-known directional time-element overcurrent relay has been taken and sufficient "brains" given it to enable it to determine what time limit it should have in its particular location.

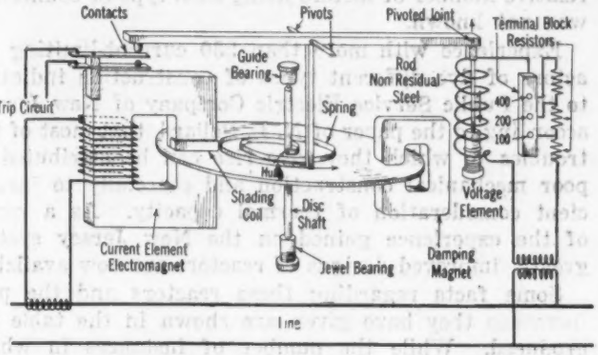


TIME-DISTANCE CURVE FOR THE DISTANCE RELAY (CRICHTON)



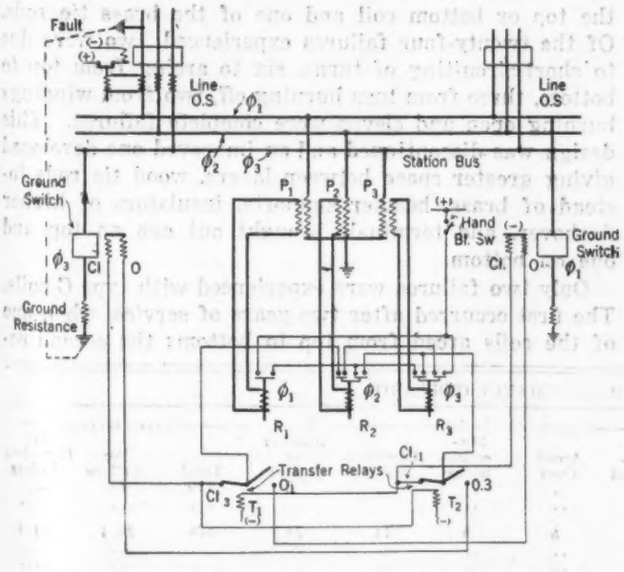
TIME-CURRENT CURVES AT VARIOUS VOLTAGES (CRICHTON)

In the opinion of P. Ackerman, who contributed a paper on "A Ground-Selector Relay Scheme," the adoption of a recently devised scheme of protection of the ground-selector type makes it possible for the ungrounded system of transmission to have all the advantages of the grounded system and some in addition. Operating results were given in the paper which, the author held, show conclusively that the ground selector



ELEMENTARY DIAGRAM OF DISTANCE RELAY WITH DIRECTIONAL ELEMENT (CRIGHTON)

will bring the ungrounded system to the same state of perfection that is claimed for the grounded system without having to resort to artificial grounding methods; also that the ground selector prevents permanent secondary breakdowns and permits clearance of grounds and line trouble as effectively as the grounded system and retains besides the advantage of less numerous voltage disturbances and partial interruptions and the flexibility of permissible transformer connections. The author said that the ungrounded system, combined with ground selectors and equipped with an effective relay protection, should therefore prove advantageous com-



CONNECTIONS OF GROUND SELECTOR RELAY (ACKERMAN)

pared with the grounded system, at least as far as distributing systems are concerned and for voltages not exceeding 60,000.

The fundamental idea of the ground selector is, he pointed out, to produce intentionally a short circuit immediately after a ground develops on the system. This is accomplished by automatically grounding one of the sound phases at the main station bus by closing an oil switch immediately upon the occurrence of a ground. Thus a complete phase to phase short circuit is produced, and as a result overload current will flow into the faulty line as if the line were on short circuit. Accordingly the ordinary overload protection will enter into action and disconnect the faulty line. As soon as the trouble has cleared itself the ground switch will open automatically and thus restore the system to normal condition. Various other features had to be embodied to make the device practical, but no great difficulty was found in developing the scheme and installing it on two systems in Canada.

Operating records over a period of time were given in detail in the paper to show the efficiency of the device for the purposes intended. The author made rigid analyses and comparisons of the ungrounded and grounded systems based upon the use of the selector scheme.

Discussion Shows that Progress Has Been Made in Relaying

R. N. Conwell suggested that many relay tests could be avoided and system operations improved if accurate records were kept of all relay operations. He also pointed out that the relay scheme developed by Mr. Ackerman was a modification of the arc suppressor and limited in its application because of complexity and cost. In his opinion, the newer relays described offered opportunity for greater developments in relay practice.

It was the opinion of P. Ackerman that an instantaneous relay placed in series with a definite time relay and connected on the balanced principle would give results similar to those derived from the relay described by Mr. Crichton. Mr. Ackerman thought great possibilities were opened by using the Crichton relay for certain applications.

W. V. Lovell stated that he could not find data to support the conclusions in the Ackerman paper to the effect that greater opportunity was offered for inductive interference under abnormal operations if the grounded neutral were used than under the scheme proposed by Mr. Ackerman.

L. P. Ferris stated that the amount of resistance in the grounded neutral will affect the amount of inductive interference appreciably and that the relative location of communication and power circuits would be a vital factor in considering the interference action if the schemes proposed by Mr. Ackerman were used.

E. A. Hester announced that a handbook on relays and protective schemes would be published in the fall under the auspices of the A. I. E. E. and N. E. L. A.

A voltage-restraining relay scheme was used for several years on the West Penn system, H. H. Langstaff stated, and gave good service in the original installation. Later this system was discontinued on account of the purchase of properties equipped with other relay schemes and because it is essential that relay applications be made quickly on every installation. He said that when using balanced protection it was essential to have a high setting to maintain the remaining line in service when one of two parallel lines is tripped on account of trouble. He also observed that it was often difficult to determine whether the ground relay or the overload relay tripped the circuit when trouble occurred. He advocated testing all relays in the laboratory before installation and said that the West Penn company had used twenty installations of 12-volt storage batteries with trickling chargers for control power and had experienced only one failure in two years.

C. M. Moss pointed out that one objection to the installation of balanced-relay schemes was the amount of control wiring and number of cross-connections required.

An interesting example of high-grade illuminating engineering design and practice was presented in a paper by F. A. Mott and L. A. Jones which described the installation for the Eastman Theater and School of Music at Rochester, N. Y. A great many experimental analyses were made previous to the installation to determine the limits for illumination and brightness. The problem was to get illumination without too much brightness so that the usual contrast between darkness and brightness in motion-picture theaters would be eliminated. At the same time, no loss of quality was desired in the pictures.

A successful solution was obtained and a detailed description was given in the paper of the equipment, controls and intensities used. Standard fixtures with ornamentation were largely used.

Reactors, Lightning Disturbance and Insulators

The importance of low ground resistance in lightning-arrester installations and the current value to consider in designing and installing reactors were the chief subjects of discussion at the Thursday morning session.

A very elaborate investigation was made by Malcolm MacLaren, professor of electrical engineering at Princeton University, of the system of the Philadelphia Electric Company with regard to lightning disturbances on the low-tension distribution lines. The main primary distribution system has 2,300 volts and the high-tension system 13,200 volts. The lightning troubles on the low-tension system are of comparatively infrequent occurrence, the author reported in his paper, "Survey of Lightning Disturbances on a Distribution System," and much less serious in character than on the other parts of the system. The number of fuses blown in the houses was no indication of the effect of lightning, because of the large number blown by other causes. The number of injuries to house fixtures never reached 150 per month, and these injuries were irregularly distributed. There was, however, distinct evidence that a majority of the meter burn-outs were due to lightning as there was a large increase in the number of failures during the summer months. All the evidence pointed to the fact that the lightning disturbances in the secondary circuits are not transmitted from the primaries to the transformers, but originated in the secondaries themselves and are controlled largely by the length of these circuits. The losses occur indiscriminately upon meters connected to ungrounded circuits or circuits grounded outside the premises or directly at the meters. No true perspective upon the protective value of these methods of connection was obtained, however, as the relative number of meters using each type of connection was not known.

Experience with more than 230 current-limiting reactors of five different types of construction indicated to the Public Service Electric Company of New Jersey, according to the paper of N. L. Pollard, that most of the troubles to which they give rise can be attributed to poor mechanical construction and especially to insufficient consideration of thermal capacity. As a result of the experience gained on the New Jersey system greatly improved designs of reactors are now available.

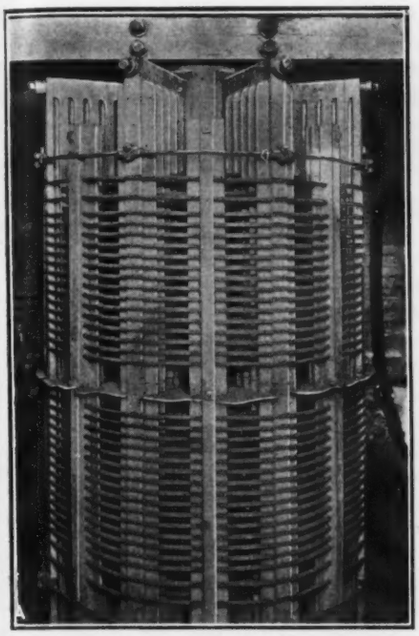
Some facts regarding these reactors and the performance they have given are shown in the table reproduced. While the number of instances in which these reactors functioned properly far exceeded the number of failures, it is in the causes of failures and the methods of overcoming them that the most valuable information lies. Only two cases of trouble developed in the type A reactors in ten years (see page 1031). The first was caused by water grounding one of the coils, and the second was caused by shrinkage of the wooden strips supporting the coils, thus allowing the windings to become slack and eventually short-circuited.

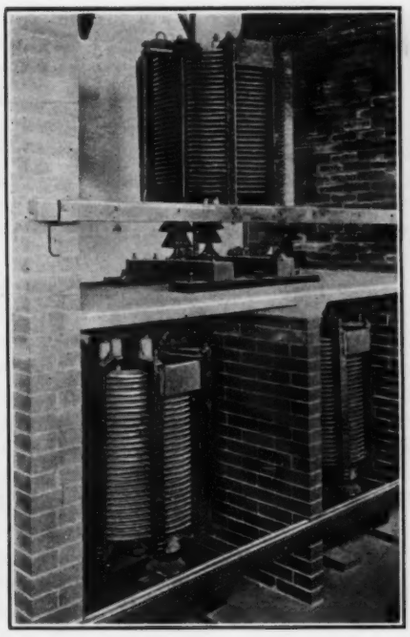
Numerous cases of short circuits and complete wreckage of type B coils indicated that they were not sufficiently braced and did not have sufficient clearance between layers and between coils and metal tie rods to withstand the severe operating conditions. In most cases failure occurred between the outer turn of either the top or bottom coil and one of the brass tie rods. Of the twenty-four failures experienced, two were due to short-circuiting of turns, six to arcing from top to bottom, three from lugs burning off, two from windings burning open and eleven were complete failures. This design was discontinued and an improved one developed giving greater space between layers, wood tie rods instead of brass, heavier supports, insulators of higher flashover, and terminals brought out one on top and one on bottom.

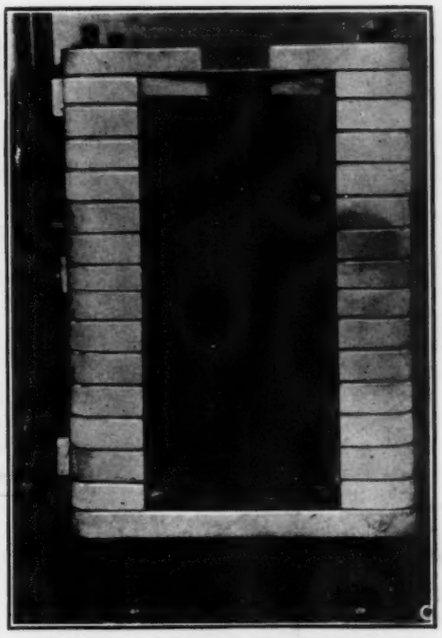
Only two failures were experienced with type C coils. The first occurred after two years of service, when one of the coils arced from top to bottom; the second oc-

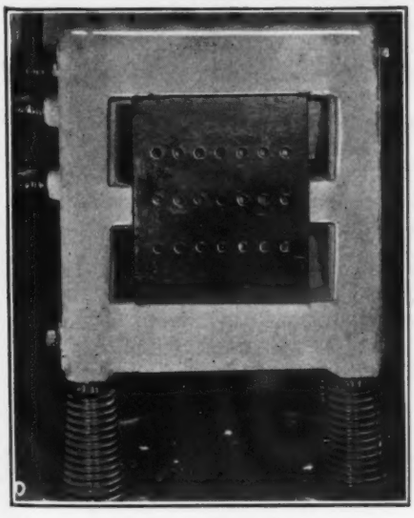
COMPARISON OF REACTOR PERFORMANCE (POLLARD)

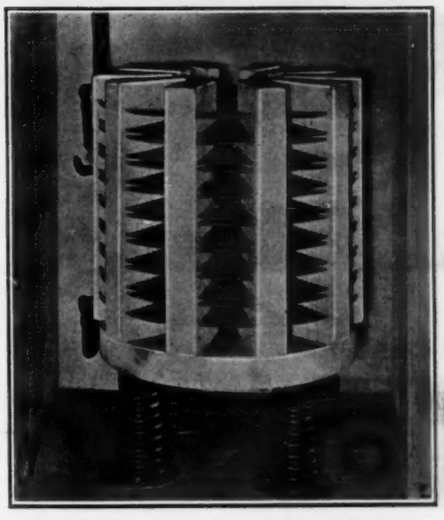
Type	Number of Reactors (All Single-Phase)	Number of Sets	Amp.	Per Cent	Kva.	Year Installed	Nature of Failure: Turns Short-Circuited	Arced Over	Miscellaneous	Complete Failure	Total Number of Failures	Reactor-Years: Total	Per Failure	Per Complete Failure
A	6	2	220	3	50.	1913	2	..	..	..	2	120	60	....
..	6	2	395	3	90.	1913	..	..	..	..	..	....	....	....
..	72	24	175	5	66.8	1914	2	6	5	11	24	676	28.1	61.4
B	12	4	250	5	95.3	1914	..	..	..	..	..	....	....	....
..	3	1	350	5	133.3	1914	..	..	..	..	..	....	....	....
..	6	2	150	5	57.1	1915	2	..	..	..	2	408	204	....
C	9	3	175	5	66.8	1915	..	..	..	..	..	....	....	....
..	12	4	250	5	95.3	1915	..	..	..	..	..	....	....	....
..	21	7	350	5	133.3	1915	..	..	..	..	..	....	....	....
..	6	2	550	2	83.9	1917	5	4	8	8	25	165	6.6	20.6
D	9	3	250	5	95.3	1917	..	..	..	..	..	....	....	....
..	15	5	350	5	133.3	1917	..	..	..	..	..	....	....	....
..	6	2	545	1.5	63.	1917	..	..	..	..	..	....	....	....
..	6	2	175	5	66.8	1919–20	..	..	3	..	3	213	71	....
E	3	1	765	1.5	88.	1917	..	..	..	..	..	....	....	....
..	9	3	250	5	95.3	1919–20	..	..	..	..	..	....	....	....
..	18	6	350	5	133.3	1919–21	..	..	..	..	..	....	....	....
..	12	4	300	8	183.	1918	..	..	..	..	..	....	....	....











FIVE TYPES OF REACTORS WITH WHICH THE NEW JERSEY COMPANY HAS HAD EXPERIENCE (POLLARD)

Type A—Earliest type of reactor installed. Type B—Coils are made of stranded conductors wound in parallel layers with notched strips and specially prepared molded non-inflammable material between layers. Non-magnetic castings are placed at the top and bottom of the coils, and the different sections are held together by brass tie rods. All the terminals are at the top of the reactor. Type C—Series-wound, similar to type B except that insulated cable is used. The axis is vertical and the coils are partly inclosed by porcelain bricks with soapstone slabs at the top and bottom, held together by brass tie rods. Type D—These coils have two sections in series, each being made up of six pancake coils in parallel. One section has a diameter approximately 3 in. less than the other. The coils have a horizontal axis and are partly inclosed with porcelain bricks. Type E—In later units of this type the concrete supports are closer together.

curred when several turns short-circuited in another coil after three years of service. Both coils were repaired and neither has given any further trouble.

Within three months after the installation of type D reactors three total failures occurred. In each case the coil caught fire from arcing between a number of turns, and before the fire could be extinguished the coils were badly burned, loosened, distorted and partly wrecked. All of the coils were on two separate occasions returned to the manufacturer for rebuilding and reinforcing without successful results. Furthermore, attempts of the New Jersey company to rebuild them were ineffective in making them strong enough to withstand short-circuit conditions. At present whenever one of these coils becomes noisy it is taken out of service and scrapped.

About one year after the first installation of type E reactors there were two instances of trouble: The first occurred on a tie feeder and resulted in the short-circuiting of two reactors; the second occurred on another tie feeder and caused the concrete to crack on one of the coils. These demonstrations were sufficient to prove that the concrete supports were not close enough to prevent the conductors from pulling together. These coils were returned to the factory and additional concrete supports placed half way between the old ones.

In conclusion, the author of the paper urged that lightning arresters be installed on the feeder side of reactors when they feed underground cable to relieve the system of strain during disturbances.

R. E. Doherty and F. H. Kierstead, in their paper on "Short-Circuit Forces on Reactor Supports," discussed and worked out in a theoretical way the character of the force which is required to hold a reactor as a whole against short-circuit forces. The mechanical stress in the supporting members of the reactor is, they found, determined by the dimensions and the magnitude of the resultant force, but under accelerated motion the reaction of the mass enters, and if the supporting members are resilient, then this enters into the situation as another factor in determining the mechanical stress produced by a given impressed force. The paper showed that if any motion be permitted in the reactor supports the mass and resiliency factor become active and the maximum stress may be increased to the order of 25 per cent. On the other hand, if the motion of the reactor is prevented by sufficient initial bolt tension, then the maximum stress need be only as great as that corresponding to the maximum instantaneous peak of the electromagnetic force. Where the reactor is not

held rigidly against the motion, the maximum force on the holding device depends in a decisive way upon the ratio of the frequency of natural oscillation to the electrical circuit frequency. If, however, the reactor is held rigidly, then the maximum force on the holding device will be independent of the frequency ratios and need be only slightly in excess of the peak magnetic force. If the reactor is not held rigidly and the natural oscillation frequency is large compared with the circuit frequency, the maximum force will occur in the first cycle and will usually be as great as or greater than the maximum magnetic force.

More analytical papers are needed to permit the solving of operating problems, declared C. E. Stone, who pointed out that the requirements for lightning arresters are conflicting. He said that the solution of line protection for 4,000-11,000-volt systems is far from solved.

Low ground resistance is absolutely imperative to good lightning arrester operation, declared K. B. MacEachron, who said that attempts of manufacturers to reduce arrester resistance would be of little avail if this was not provided. High ground resistance will either decrease discharge capacity or subject apparatus to severe voltage surges.

In referring to tests of the New York Edison Company with reactors W. B. Kirk suggested that double the sustained short-circuit-current peak value should be used in calculating reactor tests. However, J. F. Peters said that 2.8 times the sustained value is more appropriate. H. O. Stevens recommended the use of the peak value of the displaced wave.

The insulator sub-committee of the A. I. E. E. standards committee presented a report on standardized insulator tests. For pin insulators a dry flashover test is specified in detail by having the insulator mounted according to specification and voltage applied at a uniform rate of 5,000 volts per second until flashover occurs. The wet-test equipment is the same as for the dry test, and a 45-deg. spray is applied at the rate of 0.2 in. per minute. The water resistance is specified at from 3,000 ohms to 6,000 ohms per inch cube at a nozzle pressure of between 35 lb. and 50 lb. per square inch. A puncture test on the insulator immersed in oil specifies an applied voltage of not more than three-fourths the dry flashover voltage and raised at 5,000 volts per minute for insulators having an average puncture voltage of 200,000 or less and at double this rate for those having a higher puncture voltage. A corona test calls for the application of voltage in a darkened room until streamers occur and a slow lowering until brush discharges disappear. The point of disappearance is the corona voltage. A test for mechanical strength is specified while the insulator has a voltage applied 15 per cent less than the dry flashover value. The load is increased at the rate of 2,000 lb. per minute until puncture occurs.

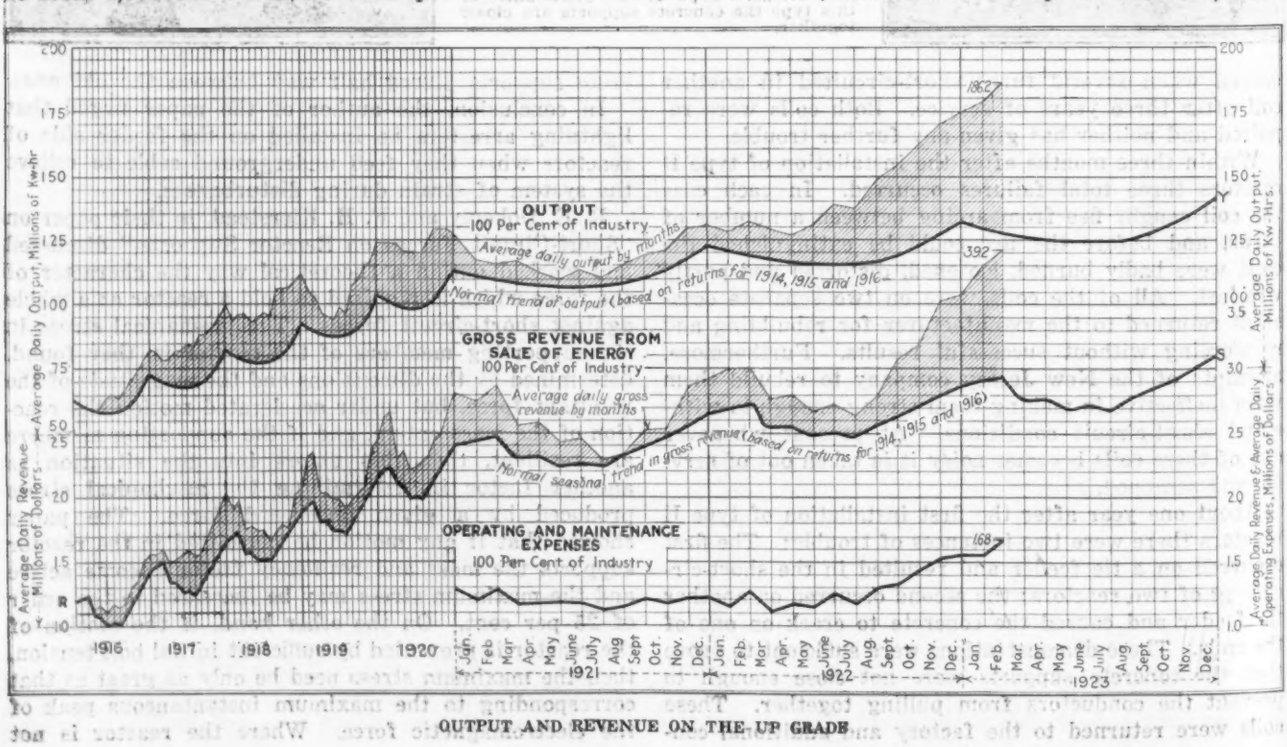
For suspension-type insulators the dry flashover test calls for the application of voltage at 5,000 volts per second until flashover occurs. All other details must conform to A. I. E. E. standards. The details of the wet flashover tests are very similar to those for the pin-insulator tests, and the same can be said of the puncture test specified by the committee. Data have been tabulated from twenty-seven operating companies in reply to a questionnaire, and specific recommendations for factory tests have been added to the former report.

February Sets Record

Unusual Energy Requirements of Central-Station Customers Reported from Every Section of the Country—Two Records Established

REPORTS received by the ELECTRICAL WORLD for the month of February from central generating and distributing companies representing 72 per cent of the installed generator rating of the country indicate that two new records were established by the industry during the month.

The average daily output during February was 186,239,000 kw.-hr., which exceeded the previous record, made


OUTPUT
100 Per Cent of Industry
Average daily output by months
Normal trend of output (based on returns for 1914, 1915 and 1916)
GROSS REVENUE FROM SALE OF ENERGY
100 Per Cent of Industry
Average daily gross revenue by months
Normal seasonal trend in gross revenue (based on returns for 1914, 1915 and 1916)
OPERATING AND MAINTENANCE EXPENSES
100 Per Cent of Industry
1862
392
168
Average Daily Revenue—Millions of Dollars
Average Daily Output, Millions of Kw-hr
Average Daily Revenue & Average Daily Operating Expenses, Millions of Dollars
Average Daily Output, Millions of Kw-Hrs.
1916
1917
1918
1919
1920
1921
1922
1923

OUTPUT AND REVENUE ON THE UP GRADE

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE MONTHS

Mos.	Percentage of Installed Ratings Represented	Kw.-Hr. Output (Companies Reporting) 1922 Thousands	1921 Thousands	Per Cent Increase	Percentage of Installed Ratings Represented	Revenue from Sale of Energy (Companies Reporting) 1922 Thousands	1921 Thousands	Per Cent Increase	Mos.	Percentage of Installed Ratings Represented	Operating and Maintenance Expenses (Companies Reporting) 1922 Thousands	1921 Thousands	Per Cent Increase	OPERATING RATIO Steam Plants 1922	Steam Plants 1921	Hydro Plants 1922	Hydro Plants 1921	Combined Systems of Steam and Hydro Plants 1922	Combined Systems of Steam and Hydro Plants 1921
Mar....	78	3,154,993	2,781,731	13.4	72	$61,148	$56,047	9.1	Mar....	55	$19,195	$19,897	—3.5	48.3	54.6	27.1	21.0	40.7	42.8
Apr....	82	3,121,346	2,769,100	12.7	75	62,784	58,484	7.4	Apr....	61	21,402	21,657	—1.2	48.3	53.9	25.3	27.6	34.8	47.7
May..	83	3,380,602	2,804,535	20.2	76	62,295	57,789	7.8	May..	62	22,785	22,378	1.8	53.7	58.1	25.1	22.4	43.3	46.0
June..	82	3,402,467	2,809,183	21.1	75	61,314	55,288	10.8	June..	62	22,770	21,848	4.2	54.2	56.9	26.4	28.1	44.9	48.5
July....	80	3,401,789	2,823,231	20.4	74	60,392	54,442	10.9	July....	61	23,006	21,556	6.7	55.3	56.8	27.9	28.5	46.1	48.1
Aug..	79	3,648,755	2,998,719	21.6	73	62,821	55,499	13.2	Aug....	60	24,932	22,435	11.1	56.6	54.2	26.8	31.4	48.8	50.7
Sept....	79	3,647,228	2,987,072	22.0	72	66,435	57,977	14.6	Sept....	59	24,555	22,353	9.8	53.4	53.2	26.4	25.8	46.9	48.3
Oct....	78	3,922,493	3,171,675	23.6	72	70,710	61,024	15.8	Oct....	59	27,781	23,260	19.5	52.1	51.1	28.9	27.8	48.1	47.7
Nov..	78	3,964,299	3,208,870	23.6	72	75,909	65,203	16.4	Nov..	59	28,308	26,071	8.6	50.4	50.2	24.3	25.0	46.0	45.3
Dec..	74	4,010,374	3,202,431	25.2	69	76,344	65,624	16.3	Dec....	57	23,789	23,691	21.5	49.3	48.3	29.7	27.7	48.8	46.2
		1923	1922			1923	1922				1923	1922		1923	1922	1923	1922	1923	1922
Jan....	74	4,088,490	3,178,151	28.6	68	79,736	67,604	17.9	Jan....	56	27,94	22,935	21.8	47.3	45.3	23.8	23.4	45.3	43.1
Feb..	72	3,754,601	2,922,269	28.4	68	74,637	61,767	20.8	Feb....	56	26,374	21,652	21.8	46.0	46.1	24.0	26.6	42.0	41.2

during January, by 8,000,000 kw.-hr. In addition, the average daily revenue from the sale of energy during the month was $3,917,000, which exceeded the former record, also made during January, by $137,000. This is the first instance in the recent history of the industry in which the operations during February have exceeded those of the previous December and January. The operations of the industry for the first two months of the year point unmistakably to one of the most prosperous years in the history of the central station.

Complete returns indicate that the total output of the central generating stations in the country for 1922 was 52,775,000,000 kw.-hr. The output in 1921 was 43,905,000,000 kw.-hr., indicating an increase over that year of industrial depression of 8,870,000,000 kw.-hr., or 20.1 per cent. The output in the past year was also 15.7 per cent over 1920, a year of great industrial activity.

The gross revenue from the sale of energy during 1922 was $1,084,000,000, indicating an increase of $139,640,000, or 14.9 per cent, over 1921. The total operating and maintenance expenses, exclusive of interest, taxes, depreciation or sinking funds, during 1922 were $481,570,000, against $432,400,000 in 1921 and $440,000,000 in 1920, a remarkable showing when the high cost of fuel is taken into consideration.

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

Month	New England States: Percentage of Installed Ratings Represented	1922 Thousands	1921 Thousands	Per Cent Increase	Atlantic States: Percentage of Installed Ratings Represented	1922 Thousands	1921 Thousands	Per Cent Increase	North Central States: Percentage of Installed Ratings Represented	1922 Thousands	1921 Thousands	Per Cent Increase	South Central States: Percentage of Installed Ratings Represented	1922 Thousands	1921 Thousands	Per Cent Increase	Pacific and Mountain States: Percentage of Installed Ratings Represented	1922 Thousands	1921 Thousands	Per Cent Increase
KW-HR. OUTPUT:																				
Mar.....	82	258,142	210,107	22.9	81	1,177,876	1,024,161	15.0	70	968,229	862,240	12.2	60	160,656	145,320	10.6	94	590,090	539,903	9.3
Apr.....	81	232,294	205,100	13.2	82	1,129,200	979,666	15.3	80	1,019,170	910,482	11.9	63	158,524	137,240	15.5	94	582,400	536,612	8.5
May....	80	241,879	200,030	20.1	83	1,207,306	984,646	22.5	82	1,108,924	935,268	18.5	60	166,171	138,576	19.9	95	656,322	546,015	20.1
June....	77	242,700	200,343	21.2	83	1,194,012	978,178	22.1	82	1,113,428	917,708	21.3	58	167,420	140,425	19.2	93	684,907	572,529	19.6
July.....	74	227,799	193,144	17.9	83	1,180,488	970,398	21.7	80	1,114,357	911,543	22.3	58	166,374	142,407	16.8	91	712,771	605,739	17.7
Aug.....	72	260,666	214,944	21.4	83	1,275,186	1,026,388	24.3	79	1,176,589	972,551	21.0	58	179,325	150,412	19.3	90	752,345	621,586	21.0
Sept.....	69	261,523	225,408	16.1	82	1,307,413	1,037,644	26.0	78	1,170,148	976,556	19.7	57	194,866	158,373	23.0	91	713,248	589,091	21.0
Oct.....	69	297,362	251,833	14.1	80	1,408,629	1,128,973	24.8	78	1,305,808	1,058,870	23.4	57	201,756	160,261	25.8	91	706,346	571,738	23.5
Nov.....	70	312,949	248,370	25.8	78	1,438,270	1,160,878	23.9	77	1,318,588	1,073,114	23.6	56	212,739	159,917	33.1	90	681,753	566,591	20.3
Dec.....	73	338,613	255,769	32.3	76	1,505,165	1,214,589	23.9	70	1,251,660	998,398	25.3	55	210,897	165,922	27.0	89	704,039	567,753	24.0
		1923	1922			1923	1922			1923	1922			1923	1922			1923	1922	
Jan.....	73	327,962	252,291	29.9	75	1,551,514	1,197,086	29.5	69	1,304,478	1,008,910	29.2	55	205,108	153,903	33.2	88	699,428	565,961	23.5
Feb.....	72	295,874	227,309	30.1	75	1,418,743	1,094,574	29.6	70	1,187,205	924,856	28.3	55	190,749	135,285	40.8	87	662,030	540,245	22.5
REVENUE																				
Mar.....	82	$6,366	$5,947	7.0	75	$23,798	$21,617	10.1	57	$17,411	$15,726	11.0	60	$4,214	$4,048	4.1	94	$9,359	$8,709	7.5
Apr.....	81	6,132	5,808	5.6	76	23,809	21,847	9.0	67	19,534	18,017	8.4	62	4,123	3,928	5.0	94	9,186	8,880	3.5
May.....	80	5,787	5,508	5.1	76	22,579	21,204	6.5	69	20,237	18,175	11.3	60	4,131	3,782	9.2	95	9,561	9,120	4.8
June....	77	5,791	5,422	6.8	76	22,351	20,437	9.5	68	19,018	16,763	13.5	58	4,138	3,806	8.7	93	10,016	8,860	13.0
July.....	74	5,729	5,301	8.1	76	21,867	19,903	9.8	67	18,709	16,411	13.9	58	4,036	3,716	8.6	91	10,051	9,111	10.3
Aug.....	72	5,968	5,415	10.2	76	22,586	19,991	13.0	66	19,702	16,760	17.6	58	4,201	3,881	8.2	90	10,412	9,440	10.3
Sept.....	69	6,335	5,754	10.1	76	24,478	20,973	16.7	66	20,516	17,592	16.6	57	4,495	4,029	11.5	91	10,612	9,629	10.2
Oct.....	69	7,055	6,370	10.7	74	26,361	22,453	17.4	66	22,130	18,716	18.3	57	4,652	4,136	12.5	91	10,512	9,319	12.8
Nov.....	70	7,744	6,875	12.6	73	28,579	24,363	17.3	66	23,659	20,037	18.2	55	5,022	4,330	16.0	90	10,905	9,598	13.6
Dec.....	73	8,440	7,099	18.9	71	29,433	25,766	14.3	59	22,192	18,530	19.8	55	5,129	4,378	17.2	89	11,150	9,851	13.2
		1923	1922			1923	1922			1923	1922			1923	1922			1923	1922	
Jan.....	73	8,509	7,284	16.8	70	31,619	26,785	18.1	58	23,222	18,874	23.3	55	5,193	4,489	15.7	88	11,143	10,172	9.5
Feb.....	72	7,954	6,715	18.4	70	29,137	24,264	20.0	59	22,222	17,674	25.8	55	5,192	4,399	18.1	87	10,132	8,715	16.2
OPERATING EXPENSES:																				
Mar.....	53	$1,800	$1,741	3.4	56	$7,140	$7,345	-2.8	38	$4,884	$5,188	-5.9	59	$2,097	$2,313	-9.3	93	$3,278	$3,310	-0.9
Apr.....	53	1,626	1,650	-1.5	56	7,322	7,295	0.3	53	7,142	7,255	-1.6	61	2,063	2,075	-0.5	93	3,249	3,382	-3.9
May.....	53	1,617	1,692	-4.4	57	7,537	7,397	1.9	55	8,369	7,848	6.7	60	1,866	2,043	-8.6	93	3,396	3,398	-0.0
June....	51	1,751	1,937	-9.6	57	7,693	7,362	4.5	54	7,730	7,132	8.4	58	2,179	2,051	6.2	92	3,365	3,421	-1.6
July.....	49	1,783	1,765	1.0	57	7,769	7,361	5.5	53	7,923	7,175	10.4	58	1,961	1,966	-0.2	90	3,570	3,289	8.5
Aug.....	47	2,003	1,973	1.5	57	8,202	7,412	10.6	52	8,943	7,363	21.4	58	2,182	1,990	9.6	89	3,637	3,577	1.6
Sept.....	46	2,029	2,091	-2.9	56	7,640	7,357	3.8	50	8,924	7,295	22.4	57	2,300	2,046	12.4	90	3,666	3,564	2.9
Oct.....	46	2,387	2,023	17.9	56	9,209	7,695	19.7	49	10,608	8,567	23.8	57	2,397	2,096	14.4	90	3,703	3,412	8.5
Nov.....	46	2,545	2,161	17.7	56	8,942	7,806	14.6	50	10,540	8,468	24.4	55	2,597	2,178	19.3	89	3,684	3,537	4.1
Dec.....	46	2,802	2,030	38.1	56	9,431	8,141	15.8	49	9,558	7,368	29.7	55	2,624	2,216	18.5	88	4,374	3,946	10.8
		1923	1922			1923	1922			1923	1922			1923	1922			1923	1922	
Jan.....	44	2,410	2,022	19.2	55	9,530	8,013	18.9	48	9,730	7,345	32.6	55	2,553	2,064	23.6	87	3,722	3,441	8.2
Feb.....	43	2,312	1,808	27.9	54	9,018	7,471	2.06	49	8,992	6,957	29.2	55	2,541	2,042	24.4	86	3,511	3,374	4.1

Grading Utilities on Service

Instructions Under Which Illinois Commerce Commission Inspectors Work in Drawing Up Their Classification—Technical, Business and Public Relations Factors Are All Taken Into Consideration

By J. HOWARD MATHEWS
Service Engineer Illinois Commerce Commission

"BY THEIR fruits shall ye know them" might be taken from its scriptural context and translated "By their service shall ye know them" for application to public utility activities. Given supervision over service as well as over other activities of the utilities, a public utility commission becomes the recipient of all sorts of complaints, some justified and many unjustified. For the purpose of bringing up the service averages of the utilities in the state, checking compliance with the service rules established by the commission, and above all forestalling as far as possible the complaints and controversies that do neither the utilities nor the public any good, the engineering section of the Illinois Commerce Commission has established a grading system under which Illinois utilities are being graded in the regular routine of inspection. Periodic reports are made, all the utilities in the state receiving copies of the grades assigned to the various localities. The first list was mailed on Aug. 10, 1922, to all electric utilities in the state, covering about seven hundred localities. The highest grade was 96.45 per cent and the lowest 56.5 per cent. Needless to say, the list attracted widespread interest. The reaction was favorable, only one organization expressing resentment, which was dispelled when the company became familiar with the detailed instructions under which the grading is done. The seriousness with which some of the utilities view the grading was shown recently when one of the larger companies desired emergency service from another large company. The latter was reluctant to furnish the service until assured by the service division of the commission that the poor voltage regulation, if any developed resulting from the abnormal load, would be overlooked in the grading.

TABLE I—TYPICAL GRADING OF AN ELECTRIC UTILITY AS SHOWN ON AN INSPECTOR'S REPORT

This form is used in grading service of electric utilities. Grades have been assumed for the various factors of service and computations made to determine the final grade.

Condition of Service	Weight	Grade	Weighted Score
Continuity of service	30	89	2,670
Voltage regulation	15	80	1,200
Handling of complaints	10	80	800
Meter testing	7	95	665
Consumers' attitude	5	80	400
Provisions for emergency	3	60	180
Adequacy of capacity	2	80	160
Construction of distribution lines	2	80	160
Maintenance of distribution lines	2	75	150
Extension policy	2	95	190
Furnishing new service	1	95	95
Adjustment of bills	1	100	100
Billing	1	90	90
Grounding of secondaries	1	60	60
Total of service	82	...	....
Records:			
Record of interruptions	5	60	300
Voltage surveys and records	5	20	100
Records of meters and tests	4	80	320
Record of complaints	4	0	000
Total for records	18	...	....
Final grade,			76.40

When any company is informed of the results of an inspection, a list showing the detailed grades given for each factor in service rating is also supplied. Some companies delegate individuals to visit the commission offices to study the grades in detail and learn how their standing may be improved, which means an improvement in service. Some have made an immediate study to remedy conditions that produced a low grading, and the engineering section of the commission has been asked in a number of cases to make another inspection so that the showing made would be better.

FACTORS IN ELECTRIC UTILITY SERVICE

The most important factors entering into electric utility service are thirteen in number. They are: (1) Continuity of service, (2) voltage and frequency regulation, (3) accuracy of meter registration, (4) construction and maintenance, (5) adequacy of capacity, (6) provisions for emergency, (7) adjustment of bills, (8) billing, (9) extension policy, (10) promptness of furnishing new service, (11) handling of complaints, (12) courtesy of utility representatives, and (13) testing of service and keeping of records.

It is fairly obvious that such items as continuity of service, voltage regulation, meter accuracy, extension policies, handling of complaints and courtesy of utility representatives have a direct bearing on public relations. The others are perhaps not so direct in their relation but are of vital importance in maintaining the factors mentioned on a satisfactory basis.

Table I shows the various factors and the weight, typical grade and typical weighted score as well as the final grade recorded on an inspection sheet. Detailed instructions to inspectors have been prepared to insure uniformity of opinion and in so far as possible to eliminate the element of personal judgment.

These instructions are so specific that by their use any one would arrive at virtually the same final grade that a commission inspector would reach. It is apparent from a study of these instructions that the grading is not based on compliance with commission rules, but rather on service conditions and on records that any well-managed company would desire to keep. For this reason the operating companies could use these instructions to grade their own service, delegating some individual to study service conditions and to assign a grade on his knowledge obtained through inspections. Such a course would, in the opinion of the writer, be highly beneficial, and some of the most progressive utilities already have it under consideration.

The method as outlined in the inspectors' instructions for arriving at the values assigned to the various factors is as follows:

Continuity of Service.—Grades for continuity of service

depend upon the total duration of outages, number of interruptions per month and the time they occur. Table II shows grades to be given under different conditions. For the purpose of grading, the following classification of interruptions has been made, those falling in class A being least serious and those in class C most serious. Specifically, interruptions should be classified as follows:

Class A

1. Between 11 p.m. and morning.
2. When service is intentionally interrupted for the purpose of working on line, in stations, etc. (It is assumed that proper notice of such interruptions will be given consumers likely to be affected.)
3. During the daytime when the interruption does not come in class B or C.

Class B

(Usually applicable to power service in small and medium-size towns.)

Where interruptions affect power users having a combined connected load of 25 hp. or more, the use of such power being at least thirty hours per month. This class will usually include interruptions to grain elevators, mills, pumps, etc., operating short hours on indefinite schedules.

Class C

1. Between dusk and 11 p.m.
2. Interruptions in the daytime where they affect power used for industrial purposes, such as manufacturing and mining, where the service is usually used on a definite schedule of several hours daily and where the interruption may result in serious economic loss to the industries.

Voltage Regulation.—To determine the grade for voltage regulation during the lighting period the deductions given in Table III should be made. If the voltage is above the standard, or below the standard at other periods than during the lighting hours, the deduction from the grade shall be only one-third of that shown in the table.

Handling of Complaints.—Grading on this is to cover courtesy of employees, promptness and efficiency in disposing of complaints and success in satisfying complainants. To assist in determining the grade, the following apportionment of percentages is to be used:

	Per Cent
1. Efficiency and promptness of employees in eliminating condition complained of	50
2. Courtesy and tact of employees	30
3. Action of company to prevent recurrence of condition	20
Note.—If no records of complaints are kept, give no more than	90

Meter Testing.—

	Per Cent
(a) If initial tests are not made, deduct	10
(b) If installation tests are overdue (depending on per cent of tests and length of time overdue), deduct	1 to 20
(c) If periodic tests are overdue, deduct 1 to 4 per cent for each per cent of meters overdue in accordance with the following:	
If 1 to 6 months overdue, deduct	1
If 7 to 12 months overdue, deduct	2
If 13 to 18 months overdue, deduct	3
If 19 to 24 months overdue, deduct	4
(d) If proper testing facilities and equipment are not provided and checked (depending on seriousness of violation), deduct	1 to 15
(e) If testing is not done in accordance with standard practice, or where proper methods are not employed, deduct	1 to 20
(f) If request tests are not willingly and properly made, deduct	10
Note 1.—If initial tests only are made, allow not more than	10
If installation tests only are made, allow not more than	20
If periodic tests only are made, allow not more than	70

Note 2.—Where installation meter tests or periodic meter tests are not yet overdue, but very nearly so, the grade given for meter testing should be determined by the judgment of the inspector and should depend upon the possibility or the likelihood that these tests will be completed within the required period in conformity with the rules.

Consumers' Attitude.—The following instructions serve as a guide in grading this particular factor of service:

Class	Attitude	Grade	Instructions for Classification
A	Excellent	95-100	Practically everybody satisfied and commending company for its service.
B	Good	85-95	Where those interviewed have practically no complaint; neither do they have any particular commendation to make, showing a general spirit of indifference.
C	Fair	70-85	Some complaint. A general feeling that service is not quite what it ought to be.
D	Poor	40-70	Attitude generally unfavorable. A general criticism of service, but public tolerant.
E	Very unfavorable	00-40	Public critical and antagonistic with possible agitation for service from some other source.

The grading is to cover the attitude toward the company, its employees and its service as this attitude has been developed through the furnishing of this particular class of service. Interviews should be held with at least two city

TABLE II—USED TO GRADE UTILITIES FOR CONTINUITY OF ELECTRIC SERVICE

Hours of Interruptions per Month			Number of Interruptions per Month (Including Kick-offs)					
Class A	Class B	Class C	0–8	9–16	17–24	25–32	33–40	41–50
0	0	0	100	98	96	94	92	90
0.35	0.25	0.20	99	97	95	93	91	89
0.70	0.50	0.40	98	96	94	92	90	88
1.00	0.75	0.60	97	95	93	91	89	87
1.50	1.00	0.80	96	94	92	90	88	86
2.00	1.40	1.00	95	93	91	89	87	85
2.50	1.60	1.25	94	92	90	88	86	84
3.00	2.00	1.50	93	91	89	87	85	83
3.50	2.35	1.75	92	90	88	86	84	82
4.00	2.65	2.00	91	89	87	85	83	81
4.50	3.00	2.25	90	88	86	84	82	80
5.00	3.40	2.50	89	87	85	83	81	79
5.50	3.75	2.75	88	86	84	82	80	78
6.00	4.10	3.00	87	85	83	81	79	77
6.50	4.50	3.30	86	84	82	80	78	76
7.00	4.85	3.60	85	83	81	79	77	75
7.50	5.25	3.90	84	82	80	78	76	74
8.00	5.65	4.20	83	81	79	77	75	73
8.50	6.00	4.50	82	80	78	76	74	72
9.00	6.40	4.75	81	79	77	75	73	71
9.50	6.80	5.00	80	78	76	74	72	70
10.00	7.20	5.30	79	77	75	73	71	69
10.65	7.60	5.60	78	76	74	72	70	68
11.35	8.00	5.90	77	75	73	71	69	67
12.00	8.40	6.25	76	74	72	70	68	66
12.65	8.80	6.50	75	73	71	69	67	65
13.35	9.20	6.85	74	72	70	68	66	64
14.00	9.60	7.20	73	71	69	67	65	63
14.65	10.00	7.50	72	70	68	66	64	62
15.35	10.50	7.80	71	69	67	65	63	61
16.00	11.00	8.10	70	68	66	64	62	60
16.65	11.50	8.40	69	67	65	63	61	59
17.35	12.00	8.75	68	66	64	62	60	58
18.00	12.50	9.10	67	65	63	61	59	57
18.65	13.00	9.40	66	64	62	60	58	56
19.35	13.50	9.70	65	63	61v	59	57	55
20.00	14.00	10.00	64	62	60	58	56	54
21.25	14.50	10.25	63	61	59	57	55	53
22.50	15.00	10.50	62	60	58	56	54	52
23.75	15.65	11.15	61	59	57	55	53	51
25.00	16.35	11.40	60	58	56	54	52	50
26.25	17.00	12.05	59	57	55	53	51	49
27.50	17.65	12.30	58	56	54	52	50	48
28.75	18.35	12.55	57	55	53	51	49	47
30.00	19.00	13.20	56	54	52	50	48	46
31.25	19.65	13.45	55	53	51	49	47	45
32.50	20.35	14.10	54	52	50	48	46	44
33.75	21.00	14.35	53	51	49	47	45	43
35.00	22.60	15.00	52	50	48	46	44	42
36.25	24.20	15.65	51	49	47	45	43	41
37.50	25.80	16.35	50	48	46	44	42	40
38.75	27.40	17.00	49	47	45	43	41	39
40.00	29.00	17.65	48	46	44	42	40	38
41.25	30.60	18.35	47	45	43	41	39	37
42.50	32.00	19.00	46	44	42	40	38	36
43.75	33.80	19.65	45	43	41	39	37	35
45.00	35.40	20.35	44	44	40	38	36	34
46.00	37.00	22.00	43	41	39	37	35	33
47.50	38.50	24.00	42	40	38	36	34	32
48.75	40.00	26.00	41	39	37	35	33	31
50.00	41.50	28.00	40	38	36	34	32	30
51.25	43.00	30.00	39	37	35	33	31	29
52.50	44.50	32.00	38	36	34	32	30	28
53.75	46.00	34.00	37	35	33	31	29	27
55.00	47.75	36.00	36	34	32	30	28	26
56.25	49.50	38.00	35	33	31	29	27	25
57.50	51.00	40.00	34	32	30	28	26	24
58.75	52.50	42.00	33	31	29	27	25	23
60.00	54.00	44.00	32	30	28	26	24	22
62.50	55.50	46.00	31	29	27	25	23	21
65.00	57.00	48.00	30	28	26	24	22	20
67.50	58.50	50.00	29	27	25	23	21	19
70.00	60.00	52.00	28	26	24	22	20	18
72.50	63.00	54.00	27	25	23	21	19	17
75.00	66.00	56.00	26	24	22	20	18	16
77.50	69.00	58.00	25	23	21	19	17	15
80.00	72.00	60.00	24	22	20	18	16	14
82.50	75.00	63.00	23	21	19	17	15	13
83.00	78.00	66.00	22	20	18	16	14	12
87.50	81.00	69.00	21	19	17	15	13	11
90.00	84.00	72.00	20	18	16	14	12	10
.....	87.00	75.00	19	17	15	13	11	9
.....	90.00	78.00	18	16	14	12	10	8

Use of Table—Column A will be used when two-thirds or more of the total time of outages is in class A.

Column B will be used when most of the total time of outages occurs in class B or when about one-half of the total time falls in class A and one-half in class C.

Column C will be used when two-thirds or more of the total time of outages falls in class C. In certain cases interpolation between the curves is recommended. For instance, if 10 per cent should fall in class A, 45 per cent in class B, 45 per cent in class C, a compromise between the results secured from curves B and C should be used.

The table is based on interruptions per month covering the nine months' period previous to the inspection or the period since the last inspection. The object in using a nine months' period is to insure that part of the period will cover the months where transmission and distribution systems are usually affected by storms; also to insure the covering of certain months not usually affected by storms

In the case of partial interruptions, multiply the duration of interruptions by the per cent of the consumers affected and consider the resultant time as a total interruption to the entire community. To illustrate: An interruption of five hours to 20 per cent of the consumers should be considered equivalent to one hour's total interruption. Interruptions to street-lighting circuits shall be counted in determining the number of interruptions per month, but their duration shall not be considered in determining hours of interruptions.

officials if possible, representatives of civic organizations, representative business men and representative consumers. If it appears necessary to give a very low grade, greater care should be taken to determine accurately the public attitude.

Provisions for Emergency.—In grading provisions for emergency make the following deductions:

1. Subtract 5 per cent for each hour of interruption per month (counting only those interruptions of thirty minutes or more duration).
2. In addition to deductions for interruptions outlined under (1), make the following deductions:

	Per Cent
(a) Two transmission lines and standby plant under steam, deduct	0 to 10
(b) One transmission line or local generating plant with reserve steam plant under steam, deduct	0 to 15
(c) Two transmission lines on different pole lines, deduct	5 to 15
(d) Two transmission lines on same pole line, deduct	10 to 20
(e) One transmission line reserve steam plant not under steam, deduct	10 to 25
(f) One transmission line—no reserve supply. Local generating plant—no reserve, deduct	15 to 40

Whether the minimum of maximum deduction is made under the above rule will depend on the following:

(a)* Dependability of source of supply (including construction and maintenance of plant, transmission line and substation).
(b) Reserve plant equipment, transformers, etc.
(c) Availability of workmen in emergency at point of trouble, consideration being given to distance to be traveled, kinds of roads, transportation, etc.
(d) Lightning arrester equipment.

*Note.—This is the only place where consideration is given to construction and maintenance of supply sources. It may seem at first glance that any deduction where standby equipment is maintained is not exactly logical but the grade assigned will depend on the protection given, viz., it might be nearly 100 per cent where the standby equipment is so located that the likelihood of service interruptions is almost nil. In less favorable situations the grade would be lower.

Adequacy of Capacity.—The following table gives the possible deductions for inadequacy of facilities:

When served entirely from local plant:	Per Cent
Generator capacity	25
Boiler capacity	20
Prime-mover capacity	20
Auxiliaries, wiring, piping, switchboards	10
Distribution system (including transformers, primaries and secondaries)	25
When served entirely or in part from transmission line:	
Source of supply capacity (including generating plant)	45
Substation capacity	30
Distribution system (including transformers, primaries and secondaries)	25

Construction of Distribution Lines.—The following table gives the possible deductions for poor construction:

Material:	Per Cent
Poles—kind, size, quality, treatment	35
Wires	10
Arms, pins, braces, insulators	10
Guys—kind and size of anchors and wire	5
Workmanship:	
Pole setting (including regularity of spacing)	20
Wire installation (sags, ties, splices)	10
Cross-arm assembly (including insulators, pins, braces and double arms)	5
Guying	5

Maintenance of Distribution Lines.—The following table gives the possible deductions for poor maintenance:

	Per Cent
Poles	30
Arms, pins, insulators, braces	25
Clearance from trees and structures	20
Clearance from other wires and from ground	15
Transformers	5
Lightning arresters	5

Extension Policy.—Grade to depend on degree of compliance with rule covering line extensions and on promptness in making extensions.

Furnishing New Service.—Grade to depend on promptness in furnishing new service where line extensions are not necessary.

Adjustment of Bills.—Grade to be based on company's policy of refunding on over-registering meters.

Billing.—Grade to depend on whether bills are sent, whether they are properly, accurately and completely made out, whether suitable form is used, and whether billing is in any other way unsatisfactory.

Grounding of Secondaries.—

	Per Cent
1. For each per cent up to 20 of transformers not grounded, deduct	2.0
For each per cent above 20, deduct	0.75
2. If grounds are not properly installed, multiply grade arrived at under (1) by 0.5 to 1.0.	

STATE OF ILLINOIS
ILLINOIS COMMERCE COMMISSION
ELECTRIC SERVICE INSPECTION

Utility ____ City ____ Pop. ____
Official ____ Title ____ Inspector ____ District ____
Distribution Voltage ____ Cycle ____ Phase ____ Date Inspection ____ Last Inspected ____
Hours of Operation ____ Consumers as of ____ 192
Local Plant: Voltage ____ Phase ____ Transmission Line: Voltage ____ Phase ____
Substation: Voltage ____ Phase ____ No., Size and Connection of Transformers ____
Nearest Office ____ Extensions and Alterations ____
Provisions for Emergency ____
Is Capacity Adequate? ____ Character of Construction ____
Is Force Sufficient? ____ Is Force Qualified? ____
Important Changes in Staff ____ Special Report ____
Interviews—City Officials ____ Others ____
Attitude ____

1. Records and Reports
2. Meter Records
3. Meter Test Records
4. Station Records
5. Complaints
6. Interruptions (Make general statement. Attach detailed record): From ____ to ____
   Summary ____ A ____ B ____ C
7. Testing Facilities
8. Meter Test Loads & Errors
9. Watt-hour Meter Accuracy
10. Demand Meter Accuracy
11. Initial Meter Tests
12. Installation Meter Tests
13. Periodic Meter Tests
14. Request Tests
15. Adjustment of Bills
16. Voltage Regulation ____ Method ____

VOLTAGE CHARTS

Same	Address	Date on	Date off	Hours on	Std.	Lighting Hours: Max.	Lighting Hours: Min.	Lighting Hours: % Variation	Outside of Lighting Hours: Max.	Outside of Lighting Hours: Min.	Outside of Lighting Hours: % Variation

17. Voltage Surveys
18. Frequency
19. Groundings of Secondaries
20. Extension of Lines
21. Information to Consumers

Section 10—G. O. No. 28. Posting of Public Notices.

G. O. No. 30—Particularly rules 201, 203, 217, 220, 221, 225, 329, 305, 306:

*Mark with cross (X) rules violated and explain nature of violation, using opposite side where necessary.

FRONT OF REPORT FORM USED BY INSPECTORS IN ESTABLISHING GRADES

The reverse side, on which the final grades are recorded, is shown in Table I.

Record of Interruptions.—Grade to be determined by judgment of inspector.

	Per Cent
If separate record is not kept, deduct	20
If duplicate record is not kept in local office, deduct	15

Voltage Surveys and Records.—Grading to be largely determined by comprehensiveness of survey.

	Per Cent
For failure to keep records, deduct	1 to 20
For failure to keep recording voltmeter in continuous use, deduct	1 to 15
If a recording voltmeter has been provided where required but no surveys have been made, give not more than	15
If duplicate records are not kept in the local office, deduct	15

Records of Meters and Tests.—

	Per Cent
If meter record is unsatisfactory as to form or completeness, deduct	1 to 40
If meter test record is unsatisfactory as to form or completeness, deduct	1 to 60
If duplicates of these records are not kept in the local office, deduct	10 to 20

Record of Complaints.—The table following gives the possible deductions for failure to show on the complaint record the indicated information:

TABLE III—TABLE OF DEDUCTIONS IN PER CENT TO BE MADE FOR VOLTAGE REGULATION BELOW THE STANDARDS ESTABLISHED BY THE ILLINOIS COMMERCE COMMISSION

The deduction depends on the number of consumers affected as well as the voltage regulation.

Per Cent Below Standard (During Lighting Hours)

Per Cent Customers Affected	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1						1	1	1	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	5
3						1	1	2	2	2	2	2	3	3	3	4	4	5	6	7	7	8	9	10
4				1	1	1	2	3	3	3	3	3	4	4	4	4	5	6	8	9	9	10	11	13
5			1	1	1	2	3	3	4	3	4	4	5	5	5	6	7	8	10	11	12	12	13	16
6			1	1	2	4	4	4	4	5	5	5	6	6	6	8	9	10	12	13	14	15	16	18
7		1	2	2	3	4	4	4	5	5	5	6	6	7	8	9	11	12	13	14	15	17	18	20
8		1	2	2	3	4	4	4	5	5	5	6	6	8	9	10	12	13	14	15	17	18	19	22
9		1	2	2	3	4	5	5	5	6	7	7	7	8	10	11	13	14	15	16	18	19	21	24
10		1	2	2	3	4	5	5	6	6	7	7	8	9	11	12	14	15	16	17	19	21	23	25
11–15		1	2	3	3	5	6	7	7	8	8	8	9	11	13	14	16	18	19	22	24	25	27	30
16–20		2	3	3	4	6	7	8	9	10	10	10	12	13	16	18	20	22	23	24	28	29	32	36
21–30		2	3	4	5	7	8	9	11	12	13	15	14	16	19	21	23	25	27	30	33	36	41	45
31–40		2	3	4	6	8	9	10	13	14	15	17	17	19	23	25	27	30	32	35	38	42	48	52
41–30		2	4	5	7	9	11	12	15	16	17	20	20	23	26	29	31	35	37	40	44	48	56	62
51–60		2	4	6	8	11	12	15	17	18	20	23	23	26	29	33	36	39	43	46	50	56	64	70
61–70		3	5	7	8	11	13	16	18	20	22	25	25	28	32	36	38	42	46	49	54	60	68	75
71–80		3	6	7	9	12	14	17	20	22	25	28	28	31	35	39	41	46	50	54	59	66	75	82
81–90		3	6	8	10	13	16	19	22	24	28	31	31	34	38	42	45	49	54	58	64	72	81	90
91–100		3	6	9	12	15	18	21	24	27	31	35	35	38	42	46	50	55	60	65	72	80	89	100

Note—If no records of results of utilities' surveys are available, give not more than 90 per cent.

	Per Cent
Final disposal	25
Result of investigation	20
Name and address	15
Date and receipt	10
Date completed	10
Time of receipt	5
Nature of complaint	5
Time of day completed	5
By whom conducted	5
If duplicate records are not kept at local office, deduct	15

Letters from Our Readers

A Place Set Apart for Suggestions, Comments and Criticisms, to Which All Men of the Electrical Industry Are Cordially Invited to Contribute

Safety Should Not Wait on the Printer

To the Editors of the ELECTRICAL WORLD:

I desire to answer the recent letter by Dana Pierce of the Underwriters' Laboratories and of the code committee in regard to the new code, since to my mind it either gives a wrong impression or indicates a very serious situation.

Mr. Pierce's letter seems to imply that, in spite of the action of the code committee in regard to changes in practice, these changes are not to be recognized until they shall have been printed and issued in some special or regular form. Does this mean that the insurance companies are not going to recognize the changes and that they intend for a time to charge the extra premiums called for by their schedules for installations that are made in violation of the 1920 code but in accordance with the recent action of the code committee? Legally an insurance company has the right to charge any premium it chooses, but I cannot believe that the insurance companies really mean to do this. I believe Mr. Pierce's letter gives the wrong impression and that the insurance companies, rather than charging extra premiums for installations made in accordance with the changes, will welcome the changes.

In the case of municipal inspection the case is somewhat different. The right of a municipal inspector to dictate the details of electric installation rests on the police power of the state to secure safety for the public. Under our constitution a municipal inspector may not do anything he chooses but must act in accordance with the law. He may reject an installation or prevent connection to it because he considers it unsafe, but may not do so to satisfy his personal prejudices.

If a municipal inspector undertakes to use his office and his power improperly, the courts have the power and right to order him to do otherwise. The municipal inspectors are not bound by any particular edition of the code, nor in fact are they bound by the code or any code.

As Mr. Pierce indicates in his letter, each inspection department has the power and right to decide for itself just when (if ever) it will adopt the changes. It has the power to adopt them when the new code is issued or at some later date. It also has the power and right to adopt them at any time, as immediately. This is fully within the right of the inspection departments, and properly so, since it is their duty to work at all times for the best construction. They are not required to wait for the printer.

A code that is revised only at periodic intervals will obviously not include the better methods that have been developed since its last revision; hence an inspection department that is working for the best construction would seem most certainly to have not only the power and right but the duty to be ahead of the last printed code. Mr. Pierce's letter, however, seems to suggest that the inspectors should for several months adopt a different policy and that they should forbid certain forms of construction, not because they are unsafe but merely because a certain book has not been printed.

If a case comes before the court, the inspector cannot testify that he rejects an installation that is safe merely because the new code has not been printed, or rather, if he should so testify, the judge will order him to approve the installation and issue the permits. In order to maintain his position, the inspector will have to testify that in his honest opinion the installation is really unsafe. Now, in regard to the changes under discussion, there may be inspectors who will honestly so testify, but the great majority of our inspectors are both honest and able, and when the situation arises will undoubtedly allow the new methods without waiting for the printing of the changes in a particular form.

We all of us realize the importance of standard rules. In many cases the advantage of such rules is sufficiently great to warrant slight departures from the best practice. The importance and advantage of standard rules is, however, by no means controlling in all cases. Some changes are best brought about gradually.

I wish to suggest the following procedure: That inspection departments should continue to allow con-

struction according to the 1920 code until the new code is printed and distributed, and also allow it for such further time as in their judgment will reasonably permit manufacturer and wiring contractor to adjust themselves to the new conditions.

That in addition the inspection departments should allow construction according to the proposed changes and also according to any other improved methods which in their opinion will result safely so far as either fire or life or other similar hazard is concerned.

That such departure from the 1920 code should in all cases be made under special inspection such that the records of any unusual happening shall be available.

There would seem to be no question that most inspection departments have the power and right to follow the above procedure, the only exception that I think of being the cases where there is a state or municipal ordinance specifying the methods of construction.

If inspection departments will continue to allow the 1920 code for a reasonable time and will also as soon as practicable allow, as alternatives and under special inspection, the better methods recently acted on by the code committee, then I believe the best results will be obtained for the public. R. S. HALE.

Some Hints About Rural Service

To the Editors of the ELECTRICAL WORLD:

I should like to offer a few comments in answer to your question which appeared in the ELECTRICAL WORLD for March 17: "How shall our farms be served with electricity?"

We are serving approximately seven hundred farms in the north central part of Ohio, as well as ten small towns having no greater population than four hundred people. The lines constructed and in operation pass probably a thousand more farms, which will give our lines seventeen hundred farm meters when development is completed. This, we estimate, will be in five years. Our average customer's light bill is $3 per month, at $1 service charge and 12 cents per kilowatt-hour consumption charge, with a discount of 10 per cent on bills of more than $5 per month. The billing fluctuates considerably throughout the year, but not so much as some "rural authorities" believe.

Our construction is all overhead, with the exception of four miles of underground line which we have placed for experimental purposes with the thought in mind that eventually (probably in twenty-five years), after the farm business is thoroughly developed, all farm circuits will be under ground. This condition will be brought about by legislation due to public opinion, which will be worked up about that time against all cheap overhead construction. Some people might ask: "Why not put these circuits under ground at the start?" This would be impossible economically. It will take twenty-five years to develop the use of electricity for power even after all the farms are connected to the lines.

My conclusions during the short period that we have been engaged in this rural business can be summed up as follows in some rules for the central-station man:

Don't plan a line that is capable of taking care of large power requirements, because the energy cannot be sold at this time.

Don't make an agreement to use farmers to do the labor on such lines. Build all lines with your own organization.

Never change your proposal after it is once submitted unless the change is for the benefit of the farmer.

Don't make any investment of company funds in the line. Each and every farmer can well afford to spend as an initial investment $800 for line, transformer, house wiring and meter. If he says he is unable and he has the acreage, he is not sufficiently "sold" on the idea of electricity.

Don't construct lines of more than 4,600 volts or less than No. 6 copper. Don't build three-phase lines; single-phase is sufficient for many years.

Wherever possible tie your lines together, using disconnecting switches at these tie-ins. This assures maximum service and capacity with few interruptions.

Don't be alarmed at rumors from your territory before the current is turned on. We find that if there is any delay through waiting for material the farmers get worried and will listen to almost anything unfavorable, even to the extent of thinking the whole project fraudulent; but, however impatient they become, just as soon as the current is turned on they will be your friends.

Use the card system for reading your meters, having the customer mark his meter reading.

Examine the transformer, meter and lightning arresters every six months at the company's expense.

Send out a circular letter every two months stressing the point that larger consumption of energy will mean cheaper rates and better service. Advertise on your meter cards.

In closing, let me inform manufacturers and central-station men, as well as contractors or persons interested in rural development, socially or economically, that the solution of the problem does not rest with the National Electric Light Association, or the Farm Bureau, or any other agency, but with the farmer as an individual and with the central-station man who will advocate and work for the things that will make rural development easier, such as immigration and small farms. Rural service can be made profitable. J. M. HEPP,

Mead Utilities Service Company, Shelby, Ohio. Rural Division.

Proper Connections for Meter-Test Set

To the Editors of the ELECTRICAL WORLD:

I note in the issue of the ELECTRICAL WORLD for March 17 a description of a meter-test set by H. S. Edwards of the Kentucky Utility Company, Pineville, Ky. The connections which Mr. Edwards shows will produce a considerable error in his results in that the meter under test will record the losses in his rotating standard. The effect of this will be that he will set his meters slower than they should be with correct connections, thus incurring a loss of income on every meter. Mr. Edwards should extend his potential wires from his rotating standard so that he can supply them with current from the service side of the meter. This can easily be done with snap connectors which may be attached to the service switch. LEON C. WHITE,

Twin State Gas & Electric Company, Bennington Division, Bennington, Vt. Manager.

A Correction

In the article entitled "Design of Alternating-Current Substation," by R. A. Hentz, in the issue of March 3, page 513, owing to editorial errors the drawings contain the words "wrought iron" instead of "weight" when applied to the compartments and transformers in the substations.

Central Station and Industrial Practice

Installation, Operation, Maintenance, Test and Repair of Generation and Distribution Equipment, and Methods of Economically Utilizing Electric Service in Large Industrial Plants

Graphical Chart for Line Problems

Charts Furnish a Convenient Means for Obtaining Voltage Drop in Distribution Layout Work—No Calculations Are Necessary When Using Charts

IN DISTRIBUTION layout work it is desirable to know the line drop in advance, and yet it is inconvenient to have to perform the usual routine calculations, especially when many problems are handled each day. The charts described in this article were devised as a means of arriving at an accurate solution of line-drop problems quickly and without having to make any calculations whatever. In this respect they have proved very convenient to use in secondary and rural primary distribution layout work. They are flexible in so far as load, distance and power factor are concerned, but can be used only for the one voltage for which they are designed. However, this is not a serious obstacle as two charts would be sufficient for most companies, one for primary and one for secondary voltage.

The charts are based directly upon the solution of line drop by means of the vector diagram (Fig. 2):

Let E_1 = load voltage (assumed constant),

θ = angle of lag (or lead) of current at load,

ϕ = "wire angle" = arc tan X/R and varies with the size and spacing of wires. The spacing is assumed to be constant for each chart, as usually standard construction will specify a certain spacing for each voltage class.

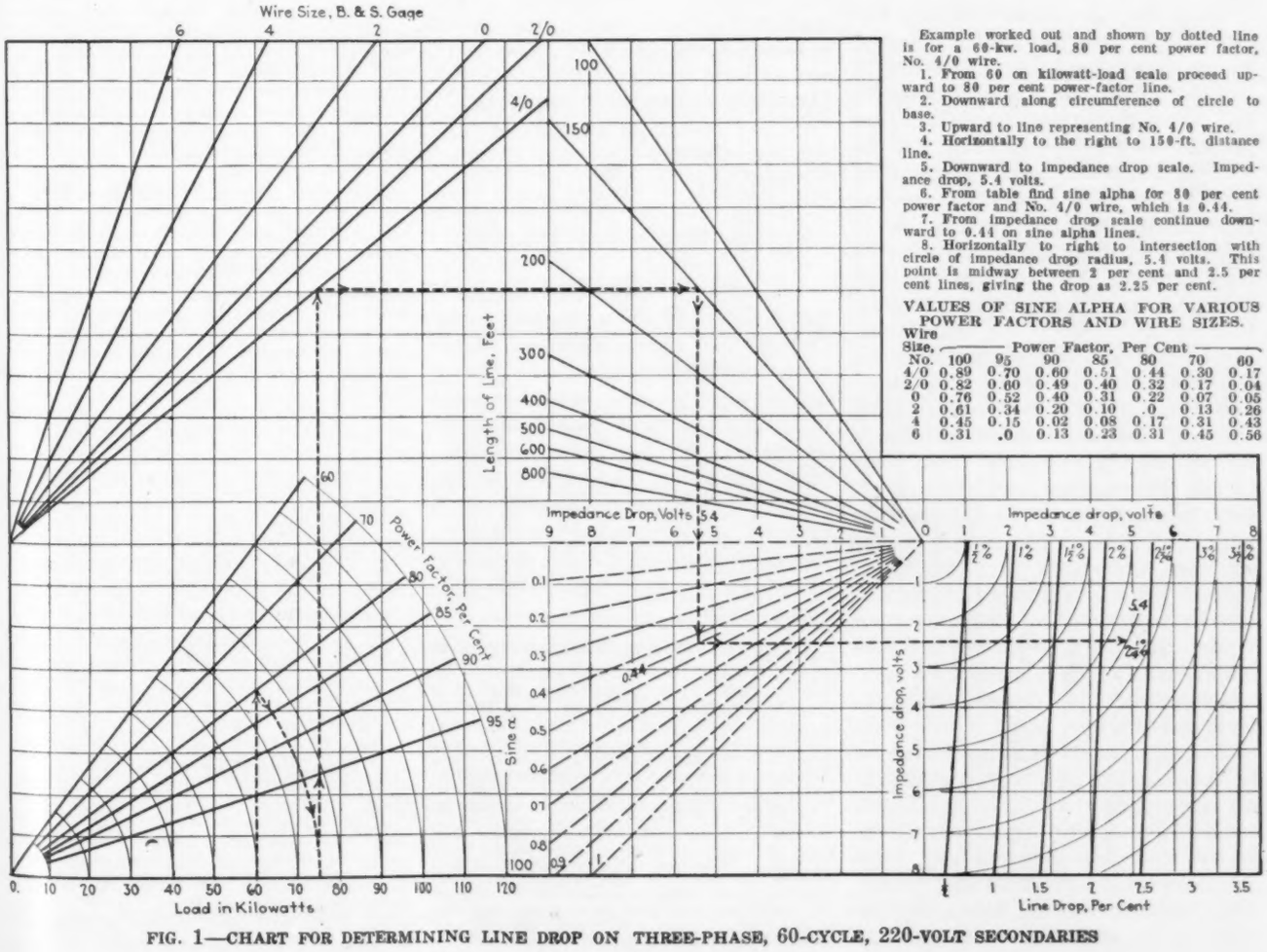
E_g = voltage at source,

E_d = impedance drop,

$E_g - E_1$ = line drop,

HDI = locus of the impedance drop vector where the magnitude of the vector remains constant, but where the power factor or wire size (or spacing) varies (i.e., where E_d remains constant in length and θ or ϕ vary);

BE = locus of impedance drop where the value of the drop varies, but for a constant value of θ and ϕ (i.e., when the power factor, wire size and spacing remain constant, the impedance drop vector will be displaced from E_1 by the angle α,



Example worked out and shown by dotted line is for a 60-kw. load, 80 per cent power factor, No. 4/0 wire.

1. From 60 on kilowatt-load scale proceed upward to 80 per cent power-factor line.
2. Downward along circumference of circle to base.
3. Upward to line representing No. 4/0 wire.
4. Horizontally to the right to 150-ft. distance line.
5. Downward to impedance drop scale. Impedance drop, 5.4 volts.
6. From table find sine alpha for 80 per cent power factor and No. 4/0 wire, which is 0.44.
7. From impedance drop scale continue downward to 0.44 on sine alpha lines.
8. Horizontally to right to intersection with circle of impedance drop radius, 5.4 volts. This point is midway between 2 per cent and 2.5 per cent lines, giving the drop as 2.25 per cent.

VALUES OF SINE ALPHA FOR VARIOUS POWER FACTORS AND WIRE SIZES.

Wire Size, No.	Power Factor, Per Cent 100	95	90	85	80	70	60
4/0	0.89	0.70	0.60	0.51	0.44	0.30	0.17
2/0	0.82	0.60	0.49	0.40	0.32	0.17	0.04
0	0.76	0.52	0.40	0.31	0.22	0.07	0.05
2	0.61	0.34	0.20	0.10	.0	0.13	0.26
4	0.45	0.15	0.02	0.08	0.17	0.31	0.43
6	0.31	.0	0.13	0.23	0.31	0.45	0.56

FIG. 1—CHART FOR DETERMINING LINE DROP ON THREE-PHASE, 60-CYCLE, 220-VOLT SECONDARIES

regardless of the magnitude of the drop vector);

$\alpha = \phi - \theta$ for lagging power factor,

$\alpha = \phi + \theta$ for leading power factor,

FCG = locus of E_g when the line drop remains constant for different combinations of power factor, wire size, and loads.

The operation of the chart is shown by dotted lines in Fig. 1. From the load scale proceed vertically to the intersection with the desired power-factor line, then downward along the circumference of a circle (whose radius is the power factor line as intersected) to the base line. This gives the equivalent kilovolt-ampere load and hence is proportional to the current. Then proceed vertically to the line representing the desired wire size. The slope of this line is equal to the impedance per unit length, and the intersected vertical value gives the impedance drop per unit length for the particular case. Next proceed horizontally to the right to the desired distance line, then downward to the impedance drop scale. This determines the magnitude of the impedance drop vector (E_d in Fig. 2) but not its direction.

Next find the factor corresponding to the wire size and the power factor from the table. This factor is the sine of the angle α (Fig. 2) and when multiplied by E_d, the impedance drop, gives M (Fig. 2), the vertical component of the impedance drop vector with respect to the extended load voltage vector. It is evident then that the intersection on HDI at a distance M from the load voltage base will determine the position of the end of the impedance-drop vector and at the same time the line drop, as shown by concentric arcs similar to FCG. To accomplish this on the chart continue downward from the impedance-drop scale to the line representing the sine α, then to the right to the intersection with the circle corresponding to the value of impedance drop as found above. This determines the position of the end of the impedance-drop vector (E_d) with respect to the concentric arcs which represent the various values of line drop and hence determines the line drop.

The arcs for scaling line drop may be constructed at equal increments of percentage drop or equal increments of voltage drop, whichever proves more convenient to use. Both the percentage drop and the voltage drop may be put on the arcs, but with most standard voltages this would involve fractional numbers, and for that reason only the percentage drop has been included on the chart shown. Likewise on charts for primary work it will be found more convenient to use some multiplier such as 20 or 50 in the impedance drop scale instead of using a scale of actual volts. This makes possible the use of small numbers

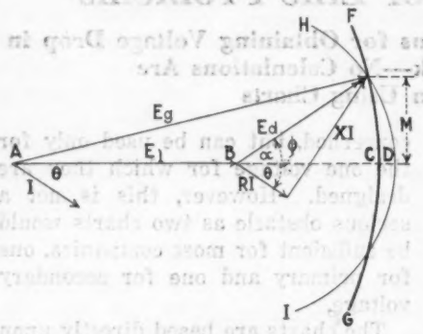


FIG. 2—LINE DROP CHART BASED ON ANALYSIS OF VECTOR DIAGRAM

and makes the chart somewhat easier to use.

If it is desired to construct a chart that can be used for both three-phase and single-phase, another scale may be added under the three-phase load scale to use for single-phase. Such a chart has been found very useful in rural distribution at 4,600 volts, where loads are handled on both single-phase and three-phase lines.

M. B. COVELL, JR.,
Distribution Engineers Department.
Detroit Edison Company,
Detroit, Mich.

Safety Rules for Electric Crane Equipment

WHEN installing electric crane equipment the safety standards inaugurated by the Electrical Safety Conference* last fall should be kept in mind. The most important items covered are trolley conductors, overhead protection and disconnecting means, limit stops and brakes, phase reversal and low-voltage protection. The additions to the rules are given in part in the following paragraph:

TROLLEY CONDUCTORS

Location.—Trolley conductors placed in the crane runway shall be located in such a position or so guarded that persons working on the crane or entering or leaving the crane cab are not likely to come into contact with live parts.

Trolley Conductors on the Bridge.—These conductors shall be so arranged or so guarded that hoisting cables cannot be brought into accidental contact with them and that persons cannot come into accidental contact with them. The installation of a light angle iron or its equivalent to prevent the hoisting cable from pulling against the bridge trolley of the conductors is considered sufficient protection.

Monorail Conductors.—Monorail runway conductors on I-beam or equivalent structural runways shall have a horizontal clearance from grounded metal parts of not less than 1½ in. if a wire is used for the conductor, or not less than 1 in. if rigid steel bars or shapes are used.

OVERLOAD PROTECTION AND DISCONNECTING MEANS

Main Fuses and Switch.—Runway trolley wires for traveling cranes, or the feeder wires for other type of cranes, shall be protected by fuses or circuit breakers and controlled by a switch which can be locked in the open position. The fuses or circuit breaker and the switch shall be so located as to be easily accessible from the floor. If the circuit breaker opens all wires and is arranged so that it can be locked in the open position, the switch can be omitted.

Bridge and Cab Switches.—A switch shall be provided by which the operator can at all times and without leaving the cab disconnect all the equipment in the cab (except pilot lights) from its source of supply. There shall be a readily accessible switch by which all the bridge circuits and equipment (except pilot lights) can be disconnected from the runway trolley conductors or other source of supply. A single switch may in some cases serve both purposes provided it has means for locking in the open position.

Individual Motor Protection.—Where there is more than one motor on a single crane each motor shall be protected by fuses or by a circuit breaker or by overload relays controlling line contactors. If fuses are used, one fuse shall be provided in each conductor. If circuit breakers or overload relays are used, the number of trip coils shall not be less than that given in the following table:

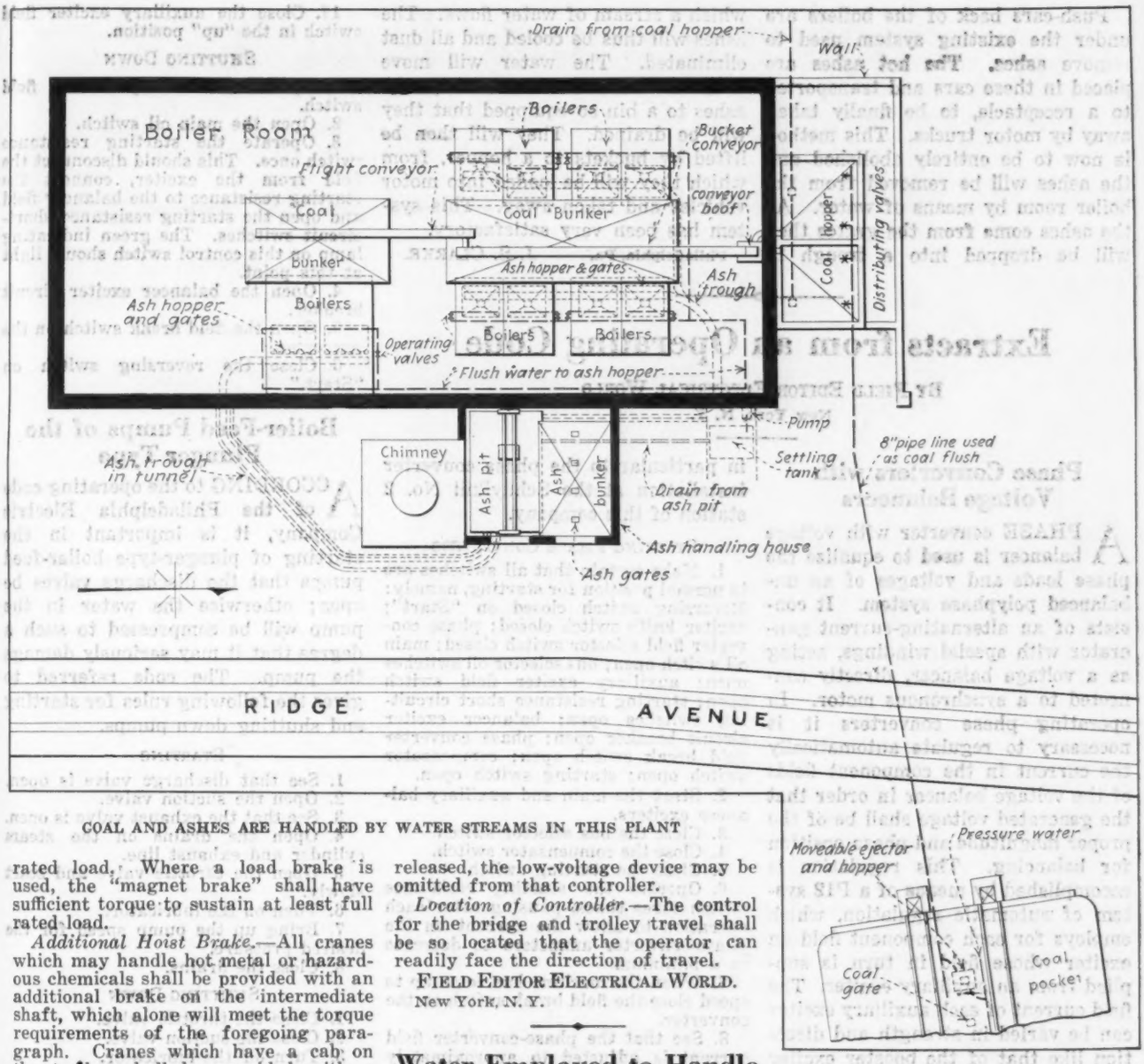
System	Number of Trip Coils
Four-wire, two-phase, A.C.	Two (one in each phase).
Three-wire, two-phase, A.C.	Two (one in each outside conductor).
Three-wire, three-phase, A.C.	Two (one in each of two phases).
Two-wire, A.C. or D. C., ungrounded	One.
Two-wire, A.C. or D. C., grounded	One (in ungrounded conductor).

LIMIT STOPS AND BRAKES

Limit Switch.—Each hoist motor shall be equipped with a limit switch so placed and arranged as to disconnect the motor and apply the brake in time to stop the motor before the hook passes the highest point of safe travel. It is preferable to have the limit switch operated directly from the hook or block.

Hoist Brakes.—Each hoist motor shall be provided with a "magnet brake" so arranged that the brake will be applied when the power is cut off from the brake magnet. This brake shall have sufficient torque to sustain at least one and one-half times the full

*The Electrical Safety Conference is composed of five organizations, namely: the Associated Manufacturers of Electrical Supplies, the Electric Power Club, the National Workman's Compensation Service Bureau, the Bureau of Standards and the Underwriters' Laboratories. Its objects are the promotion by co-operative effort of the consistent development of manufacturing and installation practice with regard to accident hazards, the development of safety standards for construction and test and the interpretation and rendering uniform of electrical safety codes.



COAL AND ASHES ARE HANDLED BY WATER STREAMS IN THIS PLANT

rated load. Where a load brake is used, the "magnet brake" shall have sufficient torque to sustain at least full rated load.

Additional Hoist Brake.—All cranes which may handle hot metal or hazardous chemicals shall be provided with an additional brake on the intermediate shaft, which alone will meet the torque requirements of the foregoing paragraph. Cranes which have a cab on the trolley shall be provided with a brake for the trolley motion. The bridge travel shall be provided with a brake. The brakes specified for the last two cases shall be capable of producing a torque sufficient to retard at the rate of not less than one foot per second per second. When manually operated, this rate of retardation shall not require a force on the brake lever in excess of 100 lb.

Phase Reversal.—The runway feeders of electric cranes operated by polyphase alternating-current motors which have their direction of rotation dependent upon the proper phase relation shall be protected by a device such as a relay which will prevent starting of any of the motors on the crane if the phase rotation of these feeders is in the wrong direction.

Low Voltage.—Each crane shall be provided with a device which will disconnect all motors from the line on failure of power and will not permit any motor to be restarted until the controller handle is brought to the central position or a reset switch or button is operated. If a controller is arranged to return automatically to the "off" position when the operating handle is released, the low-voltage device may be omitted from that controller.

Location of Controller.—The control for the bridge and trolley travel shall be so located that the operator can readily face the direction of travel.

FIELD EDITOR ELECTRICAL WORLD.
New York, N. Y.

Water Employed to Handle Coal and Ashes

TWO innovations for the removing of ashes and the conveying of coal are to be introduced in Philadelphia in connection with that city's water supply. In each case water will play an important part in the operation, and both installations are expected to facilitate the work and also reduce labor cost of conveying coal and removing ashes to and from the station.

Under the former method of operation the coal was delivered by railroad to a bunker, located some distance from the pumping station, and from this point was transferred to the station by means of motor trucks. Under this method the cost to the city of transporting the coal from the bunkers to the pumping station averaged about 20 cents per ton.

Under the new method it is estimated that the cost will be not more than 5 cents per ton, and from this there will be a much more expeditious conveyance of coal and the coal itself will be in much better condition for use owing to the cleansing action of the water.

Under the new method the coal will run from a bunker into a hopper. Near the outlet of the hopper are two pipes so arranged that the outlet of one pipe is on one side of the mouth of the hopper and the entrance to the other pipe is directly opposite to this, as shown in the accompanying illustration. A stream of water under 100 lb. pressure is driven through the pipe across the base of the hopper. As the coal comes into the hopper it is caught by the water and carried across the mouth of the hopper.

Push-cars back of the boilers are under the existing system used to remove ashes. The hot ashes are placed in these cars and transported to a receptacle, to be finally taken away by motor trucks. This method is now to be entirely abolished and the ashes will be removed from the boiler room by means of water. As the ashes come from the grates they will be dropped into a trough in which a stream of water flows. The ashes will thus be cooled and all dust eliminated. The water will move with sufficient force to carry the ashes to a bin so equipped that they will be drained. They will then be lifted by buckets to a hopper, from which they will be loaded into motor vehicles and taken away. This system has been very satisfactory.

Philadelphia, Pa. J. S. CLARKE.

Extracts from an Operating Code

BY FIELD EDITOR ELECTRICAL WORLD
New York, N. Y.

Phase Converters with Voltage Balancers

A PHASE converter with voltage balancer is used to equalize the phase loads and voltages of an unbalanced polyphase system. It consists of an alternating-current generator with special windings, acting as a voltage balancer, directly connected to a synchronous motor. In operating phase converters it is necessary to regulate automatically the current in the component fields of the voltage balancer in order that the generated voltage shall be of the proper magnitude and phase position for balancing. This regulation is accomplished by means of a P12 system of automatic regulation, which employs for each component field an exciter whose field in turn is supplied from an auxiliary exciter. The field current of each auxiliary exciter can be varied in strength and direction like that of the booster exciter under the KR system of voltage regulation.

The strength and direction of each auxiliary exciter field is regulated by a Tirrill regulator, which has, in place of a counterweight as in the KR system, a pilot coil to balance the pull of the operating coil. The pilot coil of each regulator is connected to one phase of the system being balanced—for instance, phase A-B; then the operating coil of one regulator is connected to phase B-C and that of the other to phase A-C. The connections are such that with all three phases of equal voltage the regulator arms are balanced, while any voltage distortion causes the regulators to operate in the direction to correct it. The following instructions for starting and shutting down phase converters are abstracted from the operating code of the Philadelphia Electric Company and apply in particular to the phase converter installation at the Schuylkill No. 2 station of this company.

STARTING PHASE CONVERTERS

1. Make certain that all switches are in normal position for starting, namely: Reversing switch closed on "Start"; exciter knife switch closed; phase converter field selector switch closed; main oil switch open; bus selector oil switches open; auxiliary exciter field switch open; starting resistance short circuiting switches open; balancer exciter circuit breaker open; phase converter field break switch open; compensator switch open; starting switch open.
2. Start the main and auxiliary balancer exciters.
3. Close the bus selector switch.
4. Close the compensator switch.
5. Close the starting switch.
6. Operate the starting resistance switch three times, pausing after each operation to allow the current on the phase-converter ammeters to decrease to a minimum.
7. When the machine has come up to speed close the field break switch on the converter.
8. See that the phase-converter field current is adjusted to approximately 53 amp.
9. Open the starting switch and close the main oil switch at the same time. These switches are interlocked so that the starting switch opens before the main oil switch closes thus preventing any accidents from occurring.
10. Open the compensator switch.
11. Close the balancer-exciter circuit breaker.
12. Operate the starting resistance switch once. This disconnects the starting resistance from the field and connects the field to the exciter. The red indicating lamp on this control switch should light when the starting resistance switch is operated once.
13. Close the reversing switch on "Run," holding the control switch on until the starting switch opens and running switch closes. Should the running switch fail to close, do not test it before opening the main oil switch on the converter.
14. Examine the regulator and see that the differential relay switch is closed.
15. Select alternating-current and direct-current potential with the selector switches.
16. Close the P-12 regulator switches.
17. Close the auxiliary exciter field switch in the "up" position.

SHUTTING DOWN

1. Open the auxiliary exciter field switch.
2. Open the main oil switch.
3. Operate the starting resistance switch once. This should disconnect the field from the exciter, connect the starting resistance to the balancer field and open the starting resistance short-circuit switches. The green indicating lamp on this control switch should light at this point.
4. Open the balancer exciter circuit breaker.
5. Open the field break switch on the converter.
6. Close the reversing switch on "Start."

Boiler-Feed Pumps of the Plunger Type

ACCORDING to the operating code of the Philadelphia Electric Company, it is important in the starting of plunger-type boiler-feed pumps that the discharge valves be open; otherwise the water in the pump will be compressed to such a degree that it may seriously damage the pump. The code referred to gives the following rules for starting and shutting down pumps.

STARTING

1. See that discharge valve is open.
2. Open the suction valve.
3. See that the exhaust valve is open.
4. Open the drains on the steam cylinder and exhaust line.
5. Open the throttle valve and start slowly.
6. Turn on the lubricator.
7. Bring up the pump speed for the desired pressure.
8. Close the drains.

SHUTTING DOWN

1. Close the throttle valve.
2. Close the suction valve.
3. Turn off the lubricator.
4. Close the suction and discharge valves, if shutting down for dismantling.

Voltage Limits of Instrument Circuits

A STANDARD has been adopted by the Electric Power Club that insures the protection of instrument, meter and relay circuits on alternating-current switchboards. In order to reduce the voltage on instrument wiring, on the back of switchboard panels, which must necessarily be closely grouped, the standard practice as adopted by the club shall be to use voltage and current transformers for all instruments, meters and relays connected to circuits over 150 volts. This rule does not apply to relays and contactors in unattended stations where 440 volts will be allowed.

FIELD EDITOR ELECTRICAL WORLD.
Chicago, Ill.

Central Station Business

Advertising, Selling and Service Methods
Commercial Organization and Management, Customer and Trade Relations, Public and Financial Policies, and Reports of Company Plans and Experiences

Buffalo Company Opens Appliance Store in Substation

EXTENDING the use of electrical energy and the sale of appliances by intensive educational work led the Buffalo General Electric Company to add a complete and up-to-date appliance and equipment store to its substation No. 16, just completed in the northernmost section of the city of Buffalo. The company has a large appliance department in its main building in the business district of the city, but this is its first experiment in carrying the sale of apparatus and its educational work into the residential sections of the city.

INTERIOR OF APPLIANCE SALESROOM

Because, theoretically at least, there are many excellent reasons why it is practical to combine the service and appliance store with substations located in residential districts, central-station managers will watch results of the Buffalo experiment with interest. There is an apparent overhead economy in combining the substation and the merchandise store. Adding an attractive store front to the substation makes the latter a more attractive feature of the community. Besides being a convenience to nearby residents, such a store is a constant reminder of the adaptability of electricity to home uses. When educational work is combined with everyday merchandising, the results are almost sure to be beneficial to dealers in electrical supplies in the vicinity.

A feature of the new store is its large and well-lighted display windows. It is easily the best lighted and most attractive display in that part of the city, and this is likely to prove an incentive to merchants in the vicinity to provide themselves with better-lighted display windows.

The initial display used for the opening of the new station was one well calculated to give the public a better conception of the service of the company to the community. One window was devoted to the general idea that Buffalo is fortunate in having at its gates a wonderful source of hydro-electric power. On one side was a painting of Niagara Falls with a miniature reproduction of the generating plant of the Niagara Falls Power Company at the foot of the falls. Miniature high-tension lines were shown carrying the power from Niagara Falls to the distributing plant of the Buffalo General Electric Company at Buffalo. Then by means of miniature houses, parks and streets the display demonstrated how a modern community is electrically lighted.

WINDOW DISPLAY AT BUFFALO GENERAL ELECTRIC'S COMBINED SUBSTATION AND APPLIANCE STORE

Maker-Utility "Tie-In" for Motor Advertising

AN EXPERIMENTAL newspaper advertising campaign was run for six weeks last fall by the Boston office of the General Electric Company to arouse the interest of business men in the electric motor drive. The number of inquiries received from these insertions has led to a broader development of publicity in the hope of obtaining the co-operation of utilities and local motor agencies in carrying forward the message of plant electrification. A second campaign, which is expected to run thirty-two weeks, was started March 27 in New England.

Let us talk over that motor problem-
MESSAGE TO BUSINESS MEN
G-E Motors
Better Working Conditions
Many a small business becomes large because the public knows about its light, clean, well-ventilated workrooms.
G-E Motors and Control have their share in such success—they have modernised hundreds of old-style factories and shops. With better light, no dirt, no noise, no odor; workers produce more goods—better goods at higher profits.
Your local G-E Motor dealer will advise you of many "G-E efficiencies."
If you do not know him, write or phone
SALES OFFICE
GENERAL ELECTRIC COMPANY
The Guarantee of Excellence on Goods Electrical
Motors
A GENERAL ELECTRIC PRODUCT
Let US EDISON LIGHT
CALL BEACH 3300 - Ask for the SALES DEPARTMENT

CO-OPERATIVE MOTOR ADVERTISEMENT

Representative daily papers in Boston, Springfield, Worcester and Portland will carry display advertisements, of which the one reproduced here is typical. The campaign will emphasize the economies of motor drive and invite the attention of manufacturing and central-station engineers to the problems of the "prospect." The Edison Electric Illuminating Company of Boston is co-operating in the local campaign. Similar developments are under way in Philadelphia and Chicago.

Electrical Luncheons Prove Educational Value

IN THIS group of men are a hundred members of the Bloomington (Ill.) Rotary Club who were entertained by D. W. Snyder, Jr., general manager of the Bloomington & Normal Railway & Light Company at an electrical luncheon, which was followed by an inspection of the company's plant. The week previous a similar luncheon was given to the Young Men's Club of the city.

Commenting on the value of these contacts with local clubs, Mr. Snyder said: "I am very well pleased with the results obtained by the two luncheons. They have given these men, many of them leaders in their respective fields, an opportunity to see our problems from an operating standpoint. The interest they manifested in the machinery and equipment indicated that we operators often forget that our plant has a story which is very interesting to the public. Too often we see the apparatus merely as a physical machine and fail to capitalize its value from a publicity standpoint.

"The local newspapers gave us 48½ column-inches on these luncheons so I feel that we have done something which has helped us in getting our story across to the public."

Twelve-Day Campaign Sells 140 Electric Washers

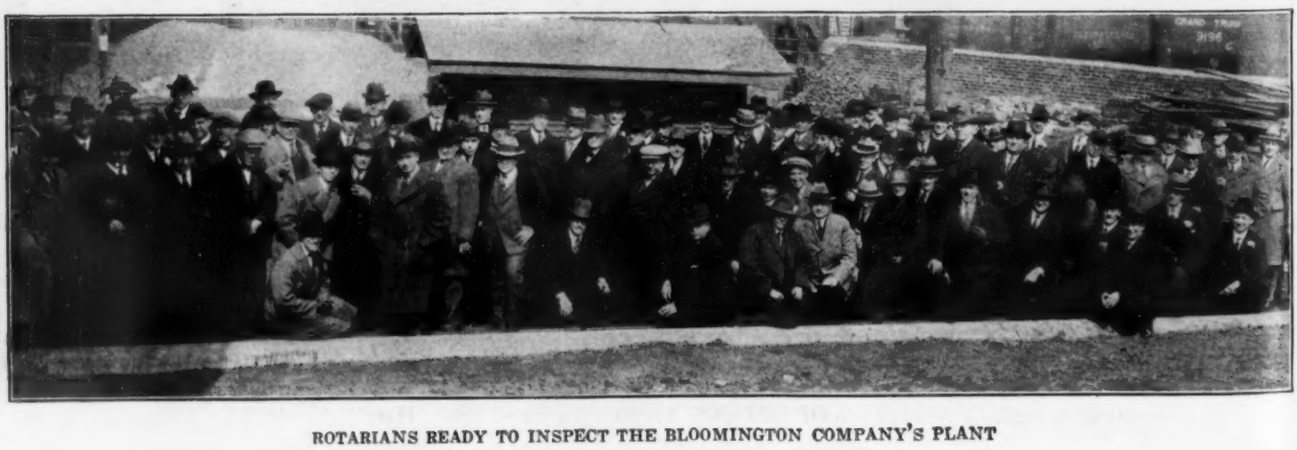
A HIGHLY successful sale of electric washing machines was recently conducted in Schenectady, N. Y., by W. M. Walsh, sales manager of that district of the Adirondack Power & Light Corporation. As a special inducement to buy during the twelve days of the sale a discount of $7.50 from the regular selling price was allowed, with a further discount of 5 per cent for cash. Deferred payments were also offered—$5 down and $12 per month.

After carefully outlining the advertising and selling program, the manufacturer's advertising department received an order for a big rush job.

"TEASER ADS" EMPLOYED

Four days before the campaign opened a series of "teaser ads" appeared in the newspapers, increasing in size, reading matter and pulling power and exciting the curiosity of readers over the announcement to follow. Each of these "ads" declared, "You Need It in Your Home," and each day a line or two was added, increasing public curiosity and giving added hints of what was to come. As a result nearly every one read the six-column display "ad" on the opening day of the campaign, which answered the "teaser ads" by declaring that what the readers needed in their homes was a Western Electric washer and wringer, giving a full description of the service and opportunity being offered to the public.

The campaign slogan was used in all newspapers, truck and store advertising throughout the two weeks. Newspaper ads featured selling points of the washer with increased emphasis on the lapse of time and number of days remaining. During the campaign trucks carried banners



ROTARIANS READY TO INSPECT THE BLOOMINGTON COMPANY'S PLANT

advertising the slogan and selling terms, and the second week emphasized the closing date. The trucks decorated were those used in making deliveries and those used by the meter department, as they do the most traveling.

Tuesday and Wednesday of the first week the public address system of the Western Electric Company was brought to Schenectady to tie in with the campaign and help to put the story across. This was also used to good advantage in connection with the chamber of commerce membership drive.

A special display truck was put on the street which carried a message all its own. An old man was seen breaking his back and wearing out his knuckles over an old washtub and scrubbing board and turning an old-fashioned wringer. In the front a dainty young lady was reading while the electric washer did the washing. The moral was the subject of the principal banner: "Would you do this? Then don't let your wife do it. Buy her an electric washer and wringer, only $5 down." This amused and interested twenty thousand workers of the General Electric Company as they passed from work.

At night the feature truck gave its show on the main street at a busy corner and moved on to Schenectady's popular vaudeville house, where floodlights made it the center of attraction. A number of women mentioned the show when salesmen called on them, and people coming into the store to buy wanted to know where the Adirondack company found the clever old farmer, who was none other that L. E. Smith, one of the company's salesmen.

OFFICE SALES

Almost every one in Schenectady goes into the Adirondack office to pay his light and gas bill. Painted on the floor was a sign displaying the campaign slogan and terms, beyond which stood a washer mounted on a table in direct line of vision. Overhead, hanging between columns, were large signs driving home the campaign message.

The manufacturer furnished folders to accompany outgoing bills, lantern slides for use in motion-picture houses, newspaper illustrations and a quantity of window displays and placards.

The front window and three side windows contained displays in regard to the washer. The rest of the store display consisted of placards and washers placed at every conceivable advantage point on the sales floor.

The outside salesmen were backed by a competent inside selling and office sales force. During the campaign the inside selling force took the names and addresses, whenever possible, of "prospects" to whom they talked on the floor, and at each morning's sales conference these names were given to the outside salesmen, according to territory, for report in forty-eight hours. Good "prospects" were offered a free home trial, which generally resulted in a sale.

A campaign is always a strenuous affair, and there are always a thousand and one details to cover. Hence every one works at top speed under a high tension. When the day's sales are good every one is radiant and buoyant; when they are low the whole world is blue and despondent and every one else is to blame. Schenectady was no exception. The first day thirteen washers were sold; no doubt some had been held over for the opening by the outside salesmen. The next day brought five; Wednesday six. Things were not looking so bright. The first week closed with fifty sales, and every one was hopeful for another good Monday. The second week closed with ninety, twenty-seven sales being made Saturday, the last day—a total of 140 for twelve days.

The sales made by outside salesmen were seventy-nine, and sixty-one were made by the office sales force.

Campaign selling, Mr. Walsh believes, is best employed as intensive propaganda to stimulate interest and educate the public, and probably the greatest benefit is the business it brings in the future. The confidence and increase in capacity and vision accruing to a sales organization as a result of a job well done are factors having a direct bearing on increased business.

The Potential Power Load on the Farm

A PROFITABLE field for devising new power applications is shown in the extent to which the farmer now uses power in his operations. Accurate data on the different types of farm power were recently presented by Prof. William Boss, chief of the division of agricultural engineering of the University of Minnesota, at the 1923 meeting of the Minnesota Engineering Society.

Of 3,611,325 hp. from animal, mechanical and electrical sources used in Minnesota alone, Professor Boss showed that only 6,000 hp., or one-sixth of 1 per cent, is from electrical sources. Farm automobiles and trucks form the biggest group, with animal power second. Professor Boss remarks that "very few people seem to realize the development that

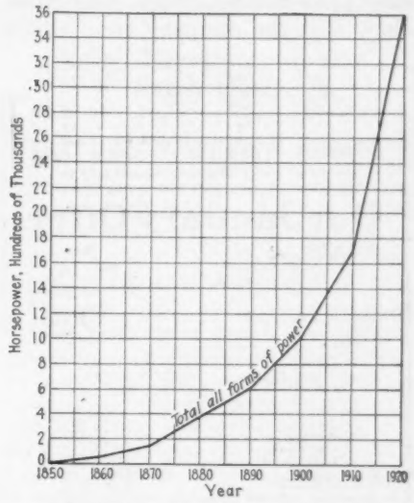


CHART SHOWING INCREASE IN USE OF POWER ON MINNESOTA FARMS

has taken place in the way of machinery and forms of power now available to the farmer. Minnesota is a comparatively young state, and it is interesting to study its development in the past twenty years and note what has taken place in the kind and amount of power used upon its farms."

The curve shows the development of the use of power on Minnesota farms and indicates the possibilities for the use of electrical energy if the proper equipment can be produced to do some of the draft work economically. The rapid growth of the various forms of mechanical power and the relatively decreasing use of animal power is an indication of the trend. According to Professor Boss's figures, the use of electrical power did not begin until 1910 and has grown very slowly since then.

AVAILABLE FARM POWER IN MINNEOSTA IN 1920

Type of Power	No. in Use	Hp. per Unit	Total Hp.	Per Cent of Total
Farm automobiles and trucks	105,524	20	2,110,480	58.0
Gas tractors	14,799	12	177,488	5.0
Gas engines	61,039	2	122,078	3.5
Windmills	35,695	1	35,695	0.9
Steam tractors	6,300	25	157,500	4.5
Horses and mules	1,001,084	1	1,001,084	28.0
Oxen	1,000	1	1,000	½ of 1
Electric	.....	..	6,000	½ of 1
Total	1,225,441	..	3,611,325	100.0

Special Offer Brings 201 House-Wiring Contracts

RETURNS from the January campaign of the Malden (Mass.) Electric Company, which offered house owners an initial installation of three wired outlets for $22 as a base price and minimum installation, show that the company received 257

Modern Ways for Modern Days

Make your home a home electrical—and enjoy the advantages of using these labor saving devices

Our January Offer

Here Is What It Is

1 Wall Outlet in Kitchen
1 Floor Outlet in Dining Room
1 Floor Outlet in Parlor

Puts Electricity in your Home for $2.00

Here Is What It Costs

$2.00 with contract—and
$2.00 per month for 11 months—or
$22.00 cash on completion of work

Here Is What It Will Do

Give you a place to use an electric iron
Give you a place to use a floor lamp
Give you a place to use a toaster, vacuum cleaner or washing machine—and supply you with current in your home to add other fixtures to when desired

Here Is The Time

Until February 1st only will we accept orders for the above—so don't procrastinate but mail coupon today, and our representative will call

MALDEN ELECTRIC CO.
SALES DEPARTMENT
141 Pleasant St. Tel. 700 MALDEN

FOLDER GIVING DETAILS OF HOUSE WIRING OFFER WITH RETURN POST CARD

inquiries, which resulted in the obtaining of ninety-one contracts, representing $4,556 worth of work. Local contractors have reported to the company from their own accounts 110 installations, making a total of 201 meters added to the Malden company's service through the publicity material setting forth the above offer.

Making Customer Owners of the Rising Generation

TO START the habit of customer partnership the Pine Bluff Company at Pine Bluff, Ark., is sending a certificate, as shown in the accompanying illustration, to each infant in its territory when the birth is recorded.

The certificate is good for $2.50 on the purchase of one or more shares of 7 per cent cumulative preferred stock of the company. In order to keep the company in the mind of the children as they grow up, an additional certificate will be sent to them on subsequent birthday anniversaries.

$2.50 The Pine Bluff Company $2.50
Pine Bluff, Arkansas

This Certificate will entitle _____ to
Two Dollars and Fifty Cents ($2.50) to apply on First Payment of one or more Shares of
7% Cumulative Preferred Stock of
The Pine Bluff Company
and make _____ a partner in the Electrical, Street Railway and Water Properties serving Pine Bluff, if presented within 30 days from date.

1923.

PRESIDENT

CERTIFICATE TO APPLY ON PURCHASE OF STOCK

Attractive Cottages for Station Operators

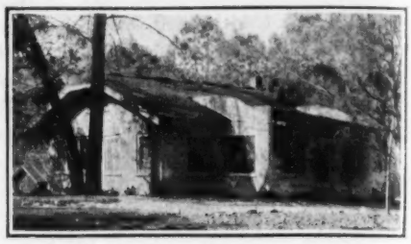
BY E. A. QUINN

General Superintendent San Joaquin Light & Power Corporation, Fresno, Cal.

IT IS the aim of the San Joaquin Light & Power Corporation to obtain the services of operators at its Kerckhoff plant who can be relied upon to remain in the employ of the company for a reasonable length of time. To accomplish this the company has provided them with attractive and comfortable living quarters. The cottages at the Kerckhoff plant, one of which is shown in the accompanying illustration, were designed and the surrounding grounds were laid out with this thought always in mind.

The houses were built at a moderate cost, are electrically heated and are provided with electric ranges and water heaters. They are equal in every respect to modern city bungalows, and visitors to the plant upon seeing them, surrounded with lawn and shade trees, are almost willing to pay for the privilege of living in one and spending the delightful summer months in the picturesque Sierra Mountains.

The cost of making an attractive central camp for the operators and their families has been so small in proportion to the cost of the construction of dam, tunnel, power house, transmission lines, etc., that


OPERATOR'S COTTAGE AT KERCKHOFF PLANT OF SAN JOAQUIN LIGHT & POWER CORPORATION

it is really not noticeable in the total. The small sum thus spent makes for more reliable, efficient and contented employees.

What Other Companies Are Doing

Medford, Ore.—The California-Oregon Power Company is organizing an entirely new department in central-station commercial activities. It is to be called the "new industries department" and it will be in charge of W. H. Crawford, formerly manager of the department of industries of the Portland (Ore.) Chamber of Commerce. The purpose of the new department will be to seek new industries and assist them in locating within the territory served by the power company in order to provide a greater sale of electrical energy.

Milwaukee, Wis. — Plans for a model electrical home, which will be a feature exhibit at the Home Building Exposition here, June 2 to 9, have been completed by the Architects' Small House Bureau. The house will be 44 ft. x 26 ft. in size and will have six rooms, bath and a model laundry. It has been designed to clear all trolley wires and low-hanging obstructions and will be specially constructed for moving, as it is to be given away on the last night of the exposition. The electrical and building industries have contributed all of the materials which enter into the construction of the house.

Los Angeles, Cal.—The first issue of "Edison Partners," an eight-page illustrated pamphlet sent quarterly to stockholders, employees and the general public by the Southern California Edison Company, has made its appearance. The purpose of the publication, according to President John B. Miller, is to acquaint all those interested in the welfare of the company with what it is doing to keep abreast of the rapidly increasing demands for electrical service in southern California.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
from All Parts of the World

Hydro-Electric Development and Steam Equipment

Remodeling Power Plant for Fuel-Oil Use.—Owing to the cost of obtaining and storing its supply of coal for the power plant at Pittsfield, the Berkshire Street Railway is making extensive changes to permit the use of fuel oil. Six boilers are being changed over, using the steam-atomizing system. A 100,000-gal. oil tank, which is filled from tank cars by gravity, provides an ample reserve supply of fuel.—*Electric Railway Journal*, March 24, 1923.

Generating Costs in 50,000-Kw. Plant Reduced 35 per Cent.—D. E. DRUEN.—Changes in operating practices and the building up of an efficient personnel, with an intimate knowledge of daily performance, have resulted in an average saving of $1,000 a day in the 50,000-kw. station of the Kansas City Railways. Although twenty years old, the station performance now compares favorably with that of many modern plants. To insure continuity of service a careful analysis was made, supplemented by additional information gathered from the station operators, revealing the various sources of the troubles. The repairs to auxiliary equipment, the overhauling and adjusting of machine governors, oil switches, disconnecting switches, control wiring, feed lines, boiler-feed pumps, etc., have eliminated the faults. Rigid rules have been laid down for the regular inspection of every unit, and operating methods have been adopted that not only tend to minimize the possibility of a service interruption but also make possible the re-establishment of service with the least delay. In regard to the organization side, an operating force of 150 men now constitutes the force, whereas 360 men were used before the plant was overhauled.—*Power*, March 28, 1923.

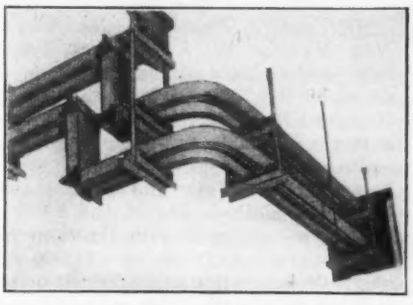
Generation, Control, Switching and Protection

Protection Against Overvoltages in the Iron and Steel Industries.—H. M. TOWNE.—Overvoltages on electric circuits occur from four distinct causes. First is a direct stroke of lightning on the circuit itself; second, induced charge or stroke which may be caused by local or distant lightning flashes or which may exist in the nature of a bound charge caused by highly charged clouds above the circuit; third, gradual accumulation of static electricity by sand, sleet, hail and snow storms, and, fourth, internal disturbances—that is, overvoltages or surges originating from switching, sudden load fluctuations, resonant conditions, arcing grounds, etc. Some of the conditions found on the iron and steel electric systems and the relation of these conditions both to the possible hazard by overvoltages and to the class of protective equipment needed are briefly reviewed. The most important factors or requisites controlling the electrical behavior of arresters are analyzed.—*Proceedings of the Association of Iron and Steel Electrical Engineers*, March, 1923.

Operating Alternating-Current Systems in Parallel.—RALPH BROWN.—Conditions to be complied with when operating two power plants in parallel with and without transformers are pointed out. Parallel operation through frequency-changer sets is also considered—*Power*, April 10, 1923.

Transmission, Substations and Distribution

Bare Aluminum Conductors.—An example is given of the usefulness of aluminum as material for heavy current busbars or for other bare station conductors. For such purposes aluminum can be used instead of copper with a very large cost saving. In addition, the weight to be supported by the insulators would be halved by such a substitution and other advantages are obtained in the direction of easier erection and better cooling. Data on the equivalent sizes of copper and aluminum bars, temperature rise, mechanical considerations and jointing are given.—*Electrician*, March 16, 1923.



BARE ALUMINUM CONDUCTORS IN A BATTERY ROOM AFTER TEN YEARS' EXPOSURE TO ACID FUMES SHOW VERY LITTLE DEPRECIATION

Electric Oscillations in Transmission Circuits Caused by the Neutral Reactor.—S. BEKKU.—The author treats the problem of electric oscillation in the transmission circuit where the neutral is grounded through the grounding reactor (in this case the Petersen coil) in a general manner, considering the line constants as concentrated. He first analyzes the single-phase system and then the three-phase system. Though a highly theoretical treatise the author visualizes the results by aid of numerical examples. The subject is considered under the following headings: Conventional representation of transmission lines, study of the steady-state phenomena, theory of symmetrical single-phase and three-phase transmission circuits, theory of faulty single-phase and three-phase transmission circuits, and miscellaneous disturbances in symmetrical three-phase transmission circuits.—*Researches of the Electrotechnical Laboratory, Tokyo, Japan*, No. 108.

Units, Measurements and Instruments

Well-Designed Hydraulic Testing Laboratory.—A thoroughly modern test flume has been built at the Holyoke Water Power Company, in which any kind of draft tube or turbine setting can be tested out. A short description of the apparatus is given.—*Electrical News*, April 1, 1923.

Teletachometer.—C. WENDT.—An electric tachometer has been developed consisting of a direct-current generator with external excitation. It is made practically independent of the excitation voltage by using a highly saturated main field, a weak compensating field and a fixed magnetic shunt. Variations of as much as 50 per cent in the excitation voltage do not affect the constant field of the generator. It is claimed that short-circuits, external magnetic fields and heating do not influence the voltage. The voltage is directly proportional to the speed of the armature, so that any moving-coil voltmeter may be used to indicate the speed of the machine driving the tachometer dynamo. With its zero point in the middle of the scale of the voltmeter, forward and backward run can be remotely indicated and measured.—*A. E. G. Mitteilungen*, February, 1923.

Illumination

Color-Matching Units in the Industries.—H. C. YOUNG.—A description is given of the proper lighting units to be used with the industries of lithographing, cotton, cigar and leather grading, dyeing and paint and chemical examination. It is pointed out that color-matching units are very desirable and practically a necessity in these industries.—*Central Station*, March, 1923.

Electric Service in the Home.—Electricity as an illuminant in the home has become such a necessity that few houses are now erected without wiring. The employment of electricity as a universal servant is, however, comparatively so recent a development that proper outlets have not been provided in the homes. This paper, which is a reprint of a booklet distributed by the Duquesne Light Company, should be of value in designing proper illumination for every room in the house. Diagrams for outlets are given for the front porch, lower hall, living room, dining room, library, kitchen, upper hall, bedroom, bathroom, sewing room, nursery, laundry, cellar, garage, pantry and sun parlor.—*National Electric Light Association Bulletin*, March, 1923.

Motors and Control

Three-Phase Motor Starter. — H. FRANKEN. — Three-phase motors with wound rotors are started by closing the main switch for the stator and moving the starter for the rotor from the zero position slowly toward the full-run position. The paper deals with the question whether or not the starter should have an open circuit in its neutral position. Both constructions have their disadvantages, but it is found that a starter with an open-circuit zero position is liable to cause more severe trouble. The most satisfactory construction is an interlocked combination of main stator switch and rotor starter. An apparatus of this type, built like a drum-controller, is shown and explained. — *Elektrotechnische Zeitschrift,* March 8, 1923.

Factors Influencing the Design of Woodworking Machinery.—S. MADSEN. —Such factors as the adoption of high-speed steel, demands of greater economy, power and speed, the use of ball bearings and the direct application of the electric drive necessitate new standards for woodworking machinery. The author discusses these factors, summarizes the problems of driving and fitting cutter heads and tells how ball bearings and electric motors overcome many of them. The savings in power resulting from the use of ball bearings and motor-driven arbors are pointed out, and the paper includes tables of synchronous-motor speeds and other motor speeds.—*Mechanical Engineering,* March, 1923.

Heat Applications and Material Handling

Advantages of Basic Electric Furnace Iron for Castings to Resist Abrasion.—L. J. BARTON.—Common white iron has many deficiencies, according to the author, inherent in the process of manufacture. The so-called synthetic iron, made in the electric furnace, has proved much more satisfactory for crusher jaws, ball-mill liners, roll shells and other parts. The characteristic properties of the common white iron made in the cupola and that made in the electric furnace are analyzed in order to show the superiority of basic electric furnace iron.—*Engineering & Mining Journal-Press,* April 7, 1923.

Electrochemistry, Electrophysics and Batteries

Some New Light on Electrolysis.—E. R. SHEPARD.—The fundamentals of stray current distribution are considered in this article. Recent researches made with the earth-current meter have made possible the statement of these fundamentals in a way which was not possible before. Potential-difference measurements between underground piping systems and adjacent electric railway tracks or the earth's potential gradient are the main factor in determining electrolysis. It has been found that many of the assumptions heretofore made in regard to the flow of currents in pipes are erroneous. The author discusses the most important factors affecting electrolysis in order to modify or clarify the prevailing conceptions regarding the flow of earth currents in such a manner as will be helpful to those who are interested in this branch of engineering and research.—*Electric Railway Journal,* April 7, 1923.

Generation of Suitable Voltages and Currents for Deep Therapy.—C. H. HOLBEACH.—In the past few years considerable strides have been made in the improvement and simplification of X-ray equipment for both medical and industrial purposes. At the same time it is a noteworthy fact that the demands of X-ray workers are ever in advance of the apparatus at their disposal. It is for this reason that standardization is difficult, a design becoming obsolete almost as soon as perfection is approached. The comparatively sudden call for highly penetrative X-radiations of shorter wave length, involving the maintenance of 200,000 volts at the tube terminals for continuous running, has imposed many difficult problems on the designer and manufacturer. In the United States these difficulties have been solved to a great extent by the research laboratories of large electrical corporations.—*Journal of the Institution of (British) Electrical Engineers,* March, 1923.

Traction

All-Electric Passenger Service for New Haven.—W. J. CLARDY.—Twelve new electric locomotives have been ordered by the New York, New Haven & Hartford Railway, and these will eliminate the steam locomotives for passenger service on the electrified section between New York and New Haven. These locomotives are of the 2-6-2 + 2-6-2 type equipped with six twin motors operating from an 11,000-volt, single-phase trolley or a 650-volt direct-current third rail. The motors have a combined rating of 2,016 hp. and will develop a tractive effort of 23,200 lb. at 32.6 miles per hour. The continuous rating is 15,800 lb. tractive effort at 39.4 miles per hour.—*Railway Age,* March 17, 1923.

Further Accomplishments of Detroit Municipal Railway Systems. — Three bulletins which deal with equipment, overhead and transportation are reviewed. How all of the practices of the Detroit United Railways have been changed under municipal operation should be of particular interest to railway men.—*Electric Railway Journal,* March 24, 1923.

Telegraphy, Telephony, Radio and Signals

The German Transcontinental Radio Station.—E. QUACK.—A short and general description is given of the German sending and receiving stations for transcontinental radio-telegraph service. The two sending stations are at Nauen and Eilvese, the receiving posts at Geltow and Hagen. The corresponding American stations are at Riverhead and Rocky Point. A telegraphing speed of as high as 130 words per minute has been reached, which is contrasted against a maximum of thirty-five words through the Atlantic cable. A diagrammatic sketch shows the path a telegram takes from a sender in Germany to a receiver in America. — *Elektrotechnische Zeitschrift,* March 8, 1923.

The Neutrodyne Receiver.—A. RINGEL. — A new principle in radio-frequency reception for neutralizing capacity effects of tubes in which true radio-frequency amplification has been apparently obtained has been developed by L. A. Hazeltine. The equipment consists essentially of a tuned amplifier which is stable, neutralization being effected by small capacities connected from grid to grid of successive radio-frequency tubes. No potentiometer is necessary, and the tuning is quite simple.—*Wireless Age,* April, 1923.

Radio Stations with Poulsen-Arc Generators.—C. W. KOLLATZ. — This paper describes the latest navy and land radio stations with a Poulsen-arc oscillator for telegraph and telephone service. A 4-kw. Danish station and a modern 10-kw. German station are described in detail. By using the Pungs control an antenna output of as high as 50 kw. may be keyed directly with a very small key. The 10-kw. sender has a wave range of 2,600 m. to 9,000 m., an antenna current of 60 amp. for telegraphy and 35 amp. for telephony. The key current for the former is only 2 amp. — *Zeitschrift des Vereines Deutscher Ingenieure,* March 10, 1923.

Miscellaneous

High-Frequency Light Relay for Talking Motion Pictures. — FRANZ AIGNER.—A perfect photo-electric cell or light relay must fulfill the three following conditions: (1) It must be inertialess, (2) it must be highly sensitive with a sufficiently large scale of sensitiveness, (3) it must utilize to the fullest extent the available wide gradation of a photographic emulsion. It has been suggested that the electromagnetic turning of the polarization plane of plane polarized light through either so-called "Faraday glass" or a cuvette containing carbon bisulphide be utilized, but the results obtained by this method have been found to be unsatisfactory on account of the distortion introduced by the self-induction of the controlling current coil. The author claims to have overcome this difficulty by using the same self-inductance as a means of tuning a high-frequency oscillating circuit and superimposing the acoustics according to well-known methods from radio telephony. The feasibility of this new method is explained mathematically. Theoretically the carbon-bisulphide would give better results, but for practical reasons the solid "Faraday glass" is preferable. A 200-cp. metal-filament lamp would give sufficient light and would obviate the disadvantages inherent in an arc lamp.—*Jahrbuch der Drahtlosen Telegraphie und Telephonie,* February, 1923.

News of the Industry

Chronicle of Important Events and General Activities, Announcements and Reports of Association Meetings, Court Decisions and Commission Rulings and News of Electrical Men

Floods in New England

Public Utilities Escape Serious Damage Despite Unprecedented Overflow of Streams

RECORD-BREAKING floods on the streams in northern New England early this week caused property damages estimated at millions of dollars, with widespread interruptions of railroad and highway transportation, especially in north central Maine, which were accompanied by temporary interruptions or curtailment of electric railway, lighting and power service. Advices by wire indicate that the water is subsiding in most of the affected districts and that the restoration of normal service will soon be accomplished.

President E. M. Graham of the Bangor (Me.) Railway & Electric Company says that the flow of the Penobscot River increased from a previous maximum record of 95,000 cu.ft. per second to 160,000 cu.ft. per second within a few days and that the hydro-electric stations of the company at Veazie and Milford had on Wednesday been out of commission for about three days. The Ellsworth plant of the affiliated Bar Harbor & Union River Power Company was shut down for about ten hours.

Nineteen out of twenty-one generators owned by these interests were under water. Trolley service was being run at about half schedule on Wednesday, and the company expected to restore electric service of all kinds to nearly normal by Friday night. Several weeks will be required to dry out the wet equipment on the system. Aside from minor washouts the dams and plants are in good condition. About three feet of water covered the operating floor at Veazie. No injuries to operators were reported on any of the Maine properties. On the Saco River high water caused inconvenience by backing up, necessitating considerable steam-plant operation.

The Central Maine Power Company sustained only moderate damage, according to late advices, although in some cases plants had to be shut down or operated at reduced rating for a time. A 110-ft. electric railway feeder tower at Augusta, Me., fell at a Kennebec River crossing Monday, but no one was seriously injured. Flood conditions in the Kennebec Valley were more troublesome than in the Androscoggin Valley, where excellent storage reservoir facilities helped in the control of excess flow.

At the New England Power Company's plant at Vernon, Vt., on the Connecticut River, output was cut down from 26,000 kw. to about 8,000 kw. on account of floodwater, and there was some reduction in capacity at other plants on the river. Little or no trouble was reported from the Deerfield River stations of this company, and J. Brodie Smith, vice-president Manchester (N. H.) Traction, Light & Power Company, wires the ELECTRICAL WORLD that high water on the Merrimac River resulted in no curtailment of service or damage to the generating stations of his company.

High Pressure at Weymouth

Turbine for Boston Edison's New Plant to Be Operated Under 1,200 Lb. of Steam

WORK on the design of the new power station of the Edison Electric Illuminating Company of Boston, which is to be built on Fore River at Weymouth, about 8 miles from the company's L Street station, has now progressed sufficiently to permit an announcement of its more important characteristics.

The station will embody several new features in design—a 1,200-lb.-pressure boiler, a 2,000-kw., 1,200-lb. turbo-generator, the reheating of exhaust steam from the high-pressure unit and the use of house generators on the shafts of the main units.

A contract for two main units has been placed with the General Electric Company. Each turbine has a steam-end rating of 32,000 kw. at 350 lb. and has a direct connection to a generator rated at 30,000 kw. and a house generator rated at 2,000 kw. Negotiations are under way with the same company for a 2,000-kw., 1,200 lb. high-pressure turbine which will exhaust through a resuperheater into the main steam system at 375 lb. The way is left open for an ultimate installation of three of the high-pressure units, and the total exhaust of the three units will supply one main 32,000-kw. unit at 350 lb.

The four boilers are furnished by the Babcock & Wilcox Company and will operate with a total steam temperature of 700 deg. F. High-pressure economizers will be used with both the three 375-lb. boilers and the 1,200-lb. boiler.

The adoption of 1,200 lb. pressure for the initial stage requires the working out of many new problems in the design of the station. The work is under the supervision of I. E. Moultrop of the Edison Electric Illuminating Company of Boston, and Stone & Webster, Inc., have been engaged to design and build the plant.

Water-Power Bill Fails Too

Governor Smith's Niagara and St. Lawrence Measure Shares Fate of Utility Bills

WITH the New York State Legislature speeding up to permit adjournment on Friday of this week, the water-power bill favored by Governor Smith, which provided for state development, distribution and control of power from the St. Lawrence and Niagara Rivers, went down to defeat by a majority of ten in the Assembly on Tuesday despite a special message from the Executive Mansion urging its passage. Thus the whole program of the Democratic administration on utility regulation and power development goes over for the verdict of the electors next fall, and its ultimate triumph or defeat will depend on which party gets a majority in the Assembly then to be elected. The Senate, which is Democratic, holds over for another year.

An important water-power measure has been introduced at Albany in the form of a constitutional amendment, presented by Senator Ferris, which provides in effect that not to exceed 3 per cent of the forest preserve may be used for the construction of power stations, the location of transmission lines, the building of dams and allied purposes.

Under present constitutional limitations, whether the state itself, private corporations or the United States government under the provisions of the water-power law were to develop hydro-electric energy at the St. Lawrence, it would be impossible to transmit it in a direct route to the capital district and New York City, because under the provisions of the New York State Constitution not a stick of timber could be cut on the Adirondack preserves for any purpose, and this would mean that transmission lines from the Long Sault Rapids would by force of necessity be carried either by way of Plattsburg and thence southerly or via Malone, Ogdensburg, Carthage and Utica around the present Adirondack reservation.

Ford Accepts Conditions

Henry Ford has accepted the conditions imposed by the Federal Power Commission in connection with the extension of rights to generate power at the High Dam on the Mississippi between St. Paul and Minneapolis. The commission also has approved informally a contract wherein Mr. Ford agrees to sell all surplus power to the Northern States Power Company at 2½c. per kilowatt-hour.

Steam Locomotives to Go

Virginian Railway Places Contract with Westinghouse for 213 Miles of Single-Phase Electrification

A CONTRACT for the electrification of 213 miles of its track, crossing the Alleghenies between Roanoke, Va., and Mullens, W. Va., has been placed with the Westinghouse Electric & Manufacturing Company by the Virginian Railway. This is nearly half the line. The order, which includes construction of electric locomotives, power house, transformer station and apparatus, involves an expenditure of $15,000,000. The alternating-current, single-phase system will be used at 11,000 volts. Power will be supplied by a 90,000-hp. generating plant to be erected on the New River, and the voltage of the main transmission line will be 88,000.

The Virginian, which was built by the late Henry H. Rogers, has long been known as a leading exponent of mass transportation, that is, the handling of traffic by the largest and heaviest trains instead of by the equivalent in smaller trains.

Frank H. Shepard, director of heavy traction for the Westinghouse company, said, in discussing the electrification, that although the Virginian is moving 7,000,000 tons of coal a year, this is not sufficient to meet the growing demands of the area served. The limit in power of steam locomotives has been reached, and after a thorough study it decided to electrify this mountain-grade division.

"The chief advantage of electric operation lies in the greater power that can be applied to each train," Mr. Shepard said. "Three of the largest steam locomotives in use on the Virginian, the articulated Mallet type, are used to haul 5,500-ton trains over the grades, but their combined power does not exceed 7,000 hp. and their speed on the grades is only 7 miles an hour. The new electric locomotives, developing 20,000 hp. per train, will haul 9,000-ton trains up the grades at a rate of 14 miles per hour, and it will be entirely practicable in future to increase this power so that 12,000-ton trains can be handled at the same speed.

"A feature of the electric locomotive," he added, "will be the use of regenerative braking on the down grades. This method of braking will not only reduce wear on the brakeshoes and wheels and improve operation, but will also save 15,000,000 kw.-hr. of electrical energy per year."

Columbia River Investigation to Begin Soon

Definite steps to begin the investigation authorized by Congress of the Columbia River Basin in the State of Washington with respect to the reclamation of several million acres of lands included in it have been taken by the Interior Department. Much projected hydro-electric development is awaiting the outcome of this investigation.

Assistant Secretary of the Interior F. M. Goodwin, a member of the commission named by Secretary of the Interior Work to conduct the investigation, will join Director A. P. Davis of the Reclamation Service, another member of the commission, at Spokane in a few days for the purpose of outlining plans for the field work. Mr. Goodwin will make a short trip over some of the routes of the basin where it is proposed to construct diversion dams and other works, after which he will go to the Umatilla Rapids district in Oregon, Congress having appropriated the sum of $50,000 for the purpose of investigating its reclamation possibilities.

Government Promotes Nitrate Manufacture

A campaign being launched by the Department of Commerce with the idea of freeing American consumers from the domination exerted by the Chilean nitrate producers is to be under the immediate direction of Harry A. Curtis, a chemical engineer who served with the nitrate division of the Ordnance Department during the war and was chief of the Sheffield Experiment Station, where work was done on the problems in connection with the Muscle Shoals nitrate plants. He is to be assisted by William H. Walker of the American Farm Bureau Federation.

This announcement, made on May 1 by Secretary Hoover, marks the opening of active work on the nitrate problem. The investigation resolves itself largely into a study of means whereby the fixation of atmospheric nitrogen can be undertaken in this country. While it will be necessary to learn as accurately as possible the minimum price at which Chilean nitrate could be laid down at American ports, it is believed probable that no extensive investigation of the Chilean industry will be undertaken. It is held that the situation is one which can be met best by establishing sources of nitrogen within our own borders. Every effort will be made, it is believed, to induce private enterprise to undertake the manufacture of atmospheric nitrogen. If that should fail, none would be surprised were a recommendation made for large-scale experiments to be undertaken by the federal government.

E. F. W. Alexanderson of Schenectady, consulting engineer of the General Electric Company and chief engineer of the Radio Corporation of America, has appealed to the ELECTRICAL WORLD to help enlist the aid of men of the electrical fraternity in the search for his kidnapped son, Verner. He is described as a fair-haired, blue-eyed, chubby six-year-old boy. Possibly this message may reach some one whom the radio, the "movies" and the newspapers have failed to reach.

The boy was kidnapped April 30; but, in spite of nation-wide publicity, he has not, as the ELECTRICAL WORLD goes to press on May 3, been found.

Hetch Hetchy Distribution

Power from San Francisco Plant May Be Sold to Private Companies and City Network Postponed

TEMPORARY distribution by private corporations in San Francisco of the power that will be available upon the completion of the Hetch Hetchy project in about eighteen months has been suggested by City Engineer M. M. O'Shaughnessy in a report to the public utilities committee of the Board of Supervisors. Four proposals in all were made to the board in response to a request for recommendations to enable it to determine upon the best policy for the city to adopt.

Mr. O'Shaughnessy deferred making any definite recommendation, but emphasized the desirability of a temporary system of private distribution by pointing out the serious difficulties to be overcome before the city can own and operate its own distribution system. It was stated that officials of the Pacific Gas & Electric Company have signified a willingness to negotiate for the purchase of the power produced by the city's project.

An additional bond issue of $30,000,000 will be needed to complete the Hetch Hetchy work, and if arrangements for private distribution can be made, the city's financial and construction resources should be devoted to the completion of the major project. An expenditure of at least $17,000,000 would be involved in any municipal distribution system, and such an outlay at this time would virtually make impossible the thirty-million-dollar bond issue needed for additional construction. Under any plan of disposing of the power it is estimated that the city will be assured of a revenue of $1,500,000 to $2,000,000 a year for the 300,000,000 kw.-hr. that will be available for distribution to consumers when the plant is completed.

Four Alternative Proposals

Following are the four alternative proposals as stated by Mr. O'Shaughnessy in his report to the Board of Supervisors:

1. That the city distribute the power by its own system, which would involve the building of transmission lines, construction of substations and tearing up of streets, with much expense in addition to the $17,000,000 that the system itself would cost.

2. That the city distribute the power itself, following purchase of the existing distribution system of the Pacific Gas & Electric Company.

3. That the city sell the entire Hetch Hetchy output to a private corporation, with an agreement for redelivery to the city of the 40,000,000 kw.-hr. that would be required of a total annual production estimated to reach 300,000,000 kw.-hr.

4. That the city distribute the power under an agreement with a private corporation by which the latter would act as agent of the city.

Rulings by Power Board

Rule Adopted for Permits to Municipality Hits Louisville—Expiration of Priorities

PRELIMINARY permits for water-power developments may not be granted to municipalities until they can show legal authority for prosecuting the work. An opinion to that effect has been issued by the chief counsel of the Federal Power Commission and has been approved by the commission itself.

This ruling is certain to have a far-reaching effect. In many instances power developments have been delayed because of the action of municipalities in attempting to obtain the rights preferentially under the water-power act. In this opinion, however, it is held that "a municipality is not a competent applicant unless it is empowered by the laws of the state in which it is located to carry on the business of developing, transmitting, utilizing or distributing power, and that a city or other political subdivision is not competent if it is not empowered under the existing laws of its state to make the development applied for." The chief counsel pointed out that before an applicant for a license can receive a preliminary permit the applicant must be competent to receive a license. A preliminary permit, he holds, may not be given for the purpose of enabling an applicant to qualify as to competency.

This opinion was sought in connection with the application of the city of Louisville for a preliminary permit and license for the development of power at the government lock and dam in the Ohio River at Louisville. The municipality is proposing to undertake an enterprise which involves the distribution of power over a wide area in two states. As a result of the legal opinion it is anticipated that the commission will deny the application of Louisville.

The commission has approved an opinion by its chief counsel to the effect that "if a permittee within the time prescribed by his permit has filed an application for a license in proper form and accompanied by the required data, his priority will not expire with the end of the period of the permit, but will continue for such time as may be used by the commission in granting or denying the application; that the priority attaches to and inheres in the application for license and continues until the application is disposed of by withdrawal, denial or the grant of the license."

Airplane Used to Map Route of New Coatesville Line

An airplane was called into use in a recent survey of a projected transmission line from the McCall's Ferry power plant of the Pennsylvania Water & Power Company at Holtwood, Pa., to Coatesville, Pa. The airplane flew in a bee line at a height of two miles and a photograph was taken every few seconds. After the flight was completed and the pictures had been developed they were pieced together and an absolutely accurate bird's-eye map of the route, showing a strip 5 miles wide and about 30 miles long, resulted. A great saving in time and effort was thus accomplished.

The new transmission line, which is to supply power to the Chester Valley Electric Company, will be operated first at 73,000 volts, but is designed for ultimate operation at 110,000 volts. It will be a double-circuit steel-tower system of the best type. A new substation is to be built by the Chester Valley company at Newlinville, near Coatesville and in proximity to the steel mills which are the company's largest power customers. The substation and the transmission line will together cost more than a million dollars. A long-term contract with the Pennsylvania Water & Power Company will, F. W. Harris, general manager of the Chester Valley Electric Company, announces, take care of the power requirements of Coatesville and its vicinity for many years to come. The plan is in accordance with the modern idea of super-power and will obviate the building of a new generating station by the Chester Valley company.

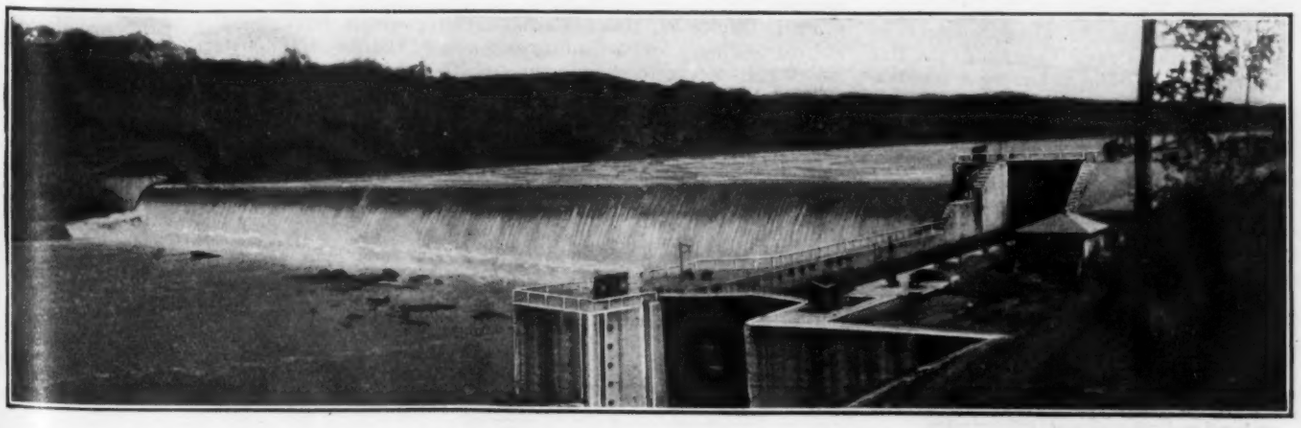
How Alabama Company Can Use Lock 17

Will Furnish Several Thousand Horsepower at Full Flow and Act as Voltage Booster in Low-Water Season—Tuscaloosa District Will Benefit—If License Is Granted, Work Will Be Pushed

THE petition filed with the Federal Power Commission by the Alabama Power Company for a license to develop power at the government's navigation dam, Lock 17, on the Warrior River, about 20 miles above Tuscaloosa, Ala., and the similar petition filed with the Alabama Public Service Commission will, President Thomas W. Martin appears confident, be granted, although a petition has been filed with the commission against the project. This petition has been set for hearing on May 9. The sponsors are not known, but it is presumed to emanate from supporters of Henry Ford's scheme for exploiting Muscle Shoals.

Although the dam at Lock 17 is 63 ft. high and 1,200 ft. long, the flow of the Warrior is so varied that its use for the development of power has long been considered economically impracticable, and officials of the Alabama Power Company say that any power development of any kind at that point is possible only because of the company's ability to tie in the proposed plant at Lock 17 with its six other hydro-electric and steam generating stations. At certain seasons of the year the Warrior is a raging torrent, capable of generating several thousand horsepower of electricity, and at other seasons the stream flow is barely sufficient to turn the waterwheels. During the latter periods, however, it could do what is known as "float" the generators on the line, making the plant valuable as a voltage booster for the Tuscaloosa district, which is at the end of a single-circuit line. The proposed use of Lock 17 by the company is considered a boon to Tuscaloosa, as it will be the means of bettering the power service of that city.

One reason for the belief that the application will be granted is the fact that the Alabama Power Company is the sole agency in the state with sufficient reserve steam-plant capacity to make use of seasonal power such as that at Lock 17. It is pointed out that



LOCK 17, PROPOSED SITE OF PLANT TO BE ERECTED BY THE ALABAMA POWER COMPANY TO SERVE WESTERN ALABAMA

when the water is low in the Warrior the shortage could be supplied from the company's reserve steam plants at Gorgas or Gadsden or from the Muscle Shoals plant leased from the government, and that when there is sufficient water in the Warrior to operate the Lock 17 plant, its use would be the means of saving many tons of coal. In addition, the government would derive some revenue from the use of this power, which has been going to waste since the completion of the dam in 1915. A power house would have to be constructed by the company and waterwheels installed, calling for a large expenditure of money, giving employment to several hundred men and ultimately resulting in the payment of taxes to the state and county on the investment made.

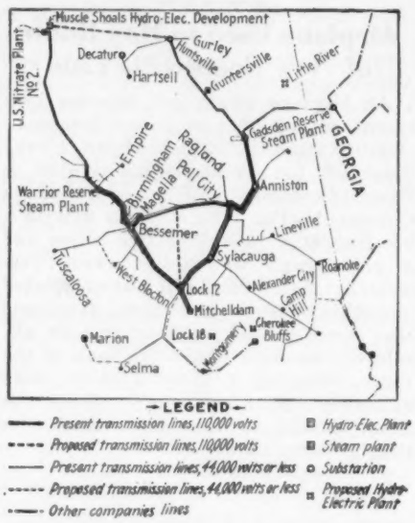
No details are available as to the size of the proposed development, it being necessary for the engineers of the company to work these out in conjunction with the Federal Power Commission. It is understood, however, that work will be undertaken as soon after the granting of a license as is found to be possible.

Fight on Alabama Link from Sheffield to Huntsville

A fight is brewing before the Alabama Public Service Commission on the petition of the Alabama Power Company to erect a transmission line from Huntsville to Sheffield, where it would connect with the Muscle Shoals steam plant and thus complete a "power loop" in Alabama. The petition was to have been heard last week, but was postponed until May 9 on the protest of the city of Sheffield and the Sheffield Chamber of Commerce. Objections to the new line were raised at Sheffield on the theory that its erection would prejudice the bid of Henry Ford for Muscle Shoals.

After Sheffield intervened in the case, cotton mills of Huntsville, Decatur and Albany, Ala., and the chambers of commerce of these cities sent telegrams to the commission protesting against postponement of the hearing on the ground that the new line is needed to supply in an adequate manner electrically operated industries in the Tennessee Valley.

According to the announcement by the Alabama Power Company, the line it proposes to build is simply a connecting link to make a complete circuit so that Huntsville and the "Tri-Cities" may receive power from either direction. Having a complete circuit insures continued service to customers in case there should be an accident to one of the lines.



HOW LINK FROM MUSCLE SHOALS TO HUNTSVILLE WOULD COMPLETE RING

Wisconsin Advocates of Water Power Oppose Delay

Thousands of dollars would be lost and needless waste of thousands of tons of coal each year would be entailed by the passage of the water-power survey bill sponsored by E. J. Gross of Milwaukee, engineers asserted at the first hearing on the measure by a joint committee of the Wisconsin Senate and Assembly, which listened to arguments on April 25.

The opposition to the bill, which passed the Assembly by a vote of 54 to 7, waxed hottest over a provision which would prohibit further development of water-power sites for six years. No objection was voiced to that section, of the bill providing for a survey of water-power sites, though it was maintained that a thorough investigation would necessitate a much larger expenditure than the sum of $25,000 which the bill carries.

Prof. Daniel W. Mead, Madison, consulting engineer and a leading authority on water-power development in the United States, raised the principal objections to the bill, which, he said, could accomplish no useful purpose and meant a halt in the material development of the state. It would entail a loss of millions in money to the state and to its citizens in interest on moneys already invested, in consequential losses of taxes and in the unnecessary consumption in the proposed six-year period of at least a million tons of coal.

"It is to the interest of all citizens and all industries in the state," declared Professor Mead, "that the development of water powers be encouraged, not threatened. They conserve coal, withdraw coal traffic from the railroads, add to the local and state income, decrease the cost of light and power, induce manufacturing and add to the comfort and convenience of all the people. No man who has an intelligent knowledge of our natural resources would favor the passage of the bill."

Cost of Electricity

Government Figures Show It to Be the One Important Commodity to Decrease in Price

THE Bureau of Labor's last quarterly statistics on the changes in the cost of living in the United States as compared with basic prices in 1913 carry an interesting footnote. Hitherto "fuel and light" have been lumped together in the table and have shown a very large increase, comparable to that in other staple commodities. In the statistics just issued, which include the figures for March, 1923, this manifest injustice to the producers and distributors of electrical energy is remedied by a line added after the total and showing an actual decrease in the price of energy as compared with December, 1914. "Fuel and light" combined show an increase in the last quarter of 86.2 per cent, compared with 42 per cent for food and 74.4 per cent for clothing, but electricity not only shows a decrease of 2.4 per cent but has shown an increase only once in the last six years—one of 1.2 in December, 1920.

The information contained in the Bureau of Labor's statistics, which are a summarization of the figures for thirty-two cities computed on a 1913 basis, is derived from actual prices which have been obtained from merchants and dealers for each of the periods named.

CHANGES IN THE COST OF LIVING IN THE UNITED STATES, 1913 TO MARCH, 1923

Item of Expenditure	Per Cent of Increase from 1913 (Average) to—												
	Dec. 1917	Dec. 1918	Dec. 1919	June 1920	Dec. 1920	May 1921	Sept. 1921	Dec. 1921	Mar. 1922	June 1922	Sept. 1922	Dec. 1922	Mar. 1923
Food	57.0	87.0	97.0	119.0	78.0	44.7	53.1	49.9	38.7	41.0	39.8	46.6	42.0
Clothing	49.1	105.3	168.7	187.5	158.5	122.6	92.1	84.4	75.5	72.3	71.3	71.5	74.4
Housing	.1	9.2	25.3	34.9	51.1	59.0	60.0	61.4	60.9	60.9	61.1	61.9	62.4
Fuel and light	24.1	47.9	56.8	71.9	94.9	81.6	80.7	81.1	75.8	74.4	83.8	86.4	86.2
Furniture	50.6	113.6	163.5	192.7	185.4	147.7	124.7	118.0	106.2	102.9	102.9	108.2	117.4
Miscellaneous	40.5	65.8	90.2	101.4	108.2	108.8	107.8	106.8	103.3	101.5	101.1	100.5	100.3
Total	42.4	74.4	99.3	116.5	100.4	80.4	77.3	74.3	66.9	66.6	66.3	69.5	68.8
Electricity *	−4.8	**	**	−2.4	+1.2	**	**	**	−1.2	−1.2	−2.4	−2.4	−2.4

* This line shows the percent of increase (+) or decrease (−) in the price of electricity at dates mentioned as compared with price in December, 1914. These figures are based on simple averages of primary rates.
** Same as in December, 1914.

Welding Men Meet

Progress in the Electrical Process Is Shown in Report—Code Recommendations Made

WELDING storage and pressure tanks, rail joints and structural work, cast-iron welding and resistance welding were the most interesting of the technical subjects discussed at the annual meeting of the American Welding Society, held in New York April 24 to 27. Past progress in the various branches of welding and plans for future investigation and developments were outlined by the different speakers, and the electric process was shown to be advancing rapidly.

A report of the committee on welded pressure vessels was made by H. L. Whittemore. This report told of tests and conclusions therefrom which will be submitted to the boiler code committee of the American Society of Mechanical Engineers as proposed rules for welded boilers. The committee found that double-V welds are at least 25 per cent stronger than single-V welds on longitudinal seams. The weakest double-V weld tested had a strength of over 90 per cent of the base-plate strength. The maximum was 113 per cent. This type of weld was suggested as mandatory for longitudinal seams. For welded boilers the committee recommended the use of low-carbon steel (not over 0.15 per cent) with a tensile strength not over 55,000 lb. To test welded vessels it was recommended that the pressure be raised to one and one-half times working pressure, and that after this the vessel be hammered and then the pressure be raised to three times working pressure. An exception was made for cases involving complicated attachments, when the final pressure need be raised to only twice working pressure.

Electric Welding Reviewed

The committee on welded rail joints, of which Dr. G. K. Burgess, the newly appointed head of the Bureau of Standards, was chairman, reported that a program had been developed, financial support assured and experimental work well started.

A complete review of the present development of electric welding was contained in the talk of W. L. Warner. He touched on the high points in the various phases of welding practice and research. In addition, he gave a list of the latest reports and papers.

Higher welding currents, use of better material in electrodes, coated electrodes, forging and heat-treating the weld, welding cast iron, monel metal and brass were some of the advances in practice which were discussed. Application of welding to oil storage tanks and to pressure vessels was said to have many advantages over riveting.

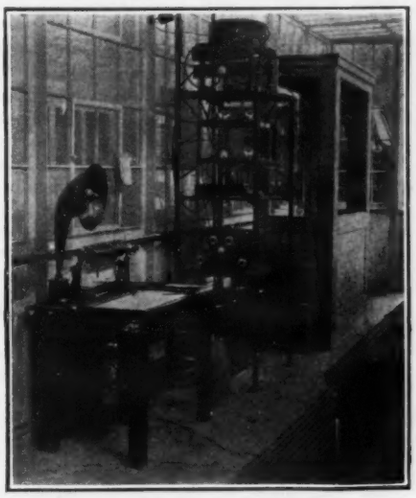
In the field of resistance welding the trend is toward higher voltage and current, lighter pressure and shorter time for welding, according to Herman Lemp. This form of welding is used successfully over a large range of work. For instance, two 24-in. seams are welded on automobile rear-axle housings requiring 1,000 kw. Seam welds are made in 0.025-in. plates of low-carbon steel, tool steel or brass. The welded portions can subsequently be swaged and rolled. An application to very small parts is in welding together tungsten and copper wires for vacuum tubes.

T. F. Barton of the General Electric Company was elected president of the society for the ensuing term. An increase in membership from 595 to 684 was reported. C. A. Adams was re-elected director, H. M. Hobart first vice-director, A. S. Kinsey second vice-director, and W. Spraragen secretary of the American Bureau of Welding, the society's research department.

Long-Distance Carrier-Current Record

Radio-Telephone System Placed in Operation on 200-Mile Transmission Line Between Pit River No. 1 and Vaca Substation Will Use 220,000-Volt Lines

ON APRIL 11 the Pacific Gas & Electric Company placed in operation a carrier radio-telephone system over its 202-mile transmission line between Pit River No. 1 plant and Vaca substation. The system utilizes the twin-circuit line between the two points built for 220,000-volt operation and will be used for directing the operation of the stations under both normal and emergency conditions. Wire communication has been carried on heretofore, but only by a very indirect route requiring five relays and necessarily subject to error and delay.



Uncompleted Carrier-Current Installation at the Pit River No. 1 Power House

The transmitting equipment is of the usual vacuum-tube telephone transmitting type similar to that used by high-power broadcasting stations. Four 250-watt and one 50-watt radiotron tube are used. Two of the tubes are used as oscillators and two as modulators, with the 50-watt tube as a speech amplifier. Wave lengths between 4,500 m. and 23,500 m. were tried and 9,200 m. was selected as the most satisfactory. At this wave length the radiation is 6 amp., and there is no interference from telegraph stations. The system is coupled to the transmission line through a single-wire antenna about 1,800 ft. long. This wire is attached to the twin vertical-circuit steel towers at a point on the center line of the tower and at the elevation of the middle arm.

The receiving equipment consists of a Colin B. Kennedy Corporation type 110 Universal receiver and a Western Electric No. 10-A loud speaker with two stages of audio-frequency amplification. Calling is accomplished by mounting a microphone in the horn of the loud speaker which when the calling circuit is completed will oscillate and "howl" in much the same manner as the ordinary telephone when the receiver is placed against the transmitter. This gives a loud note which is clearly audible in all parts of the station. Ordinarily this method of calling is not used as the operator is within hearing distance of the loud speaker. The system is arranged for simplex operation, and all that is necessary is to throw a small telephone switch which energizes a contactor to connect either the transmitting or receiving set to the antenna, thus permitting talking or listening.

The system, which was installed under the direction and supervision of Dr. Leonard Fuller, radio engineer, establishes a new record for distance for carrier radio-telephone communication. Operation has been very satisfactory, and tests indicate that normally one-half of the transmitting power of the set would be sufficient to carry on successful communication.

A. I. and S. E. E. Discusses Mine Electrification

The factors entering into the proper selection of coal-mine hoists and methods for reducing power bills were discussed in a paper presented before the Association of Iron and Steel Electrical Engineers at Pittsburgh on April 27 by F. W. Cramer and A. W. MacDonald of the Cambria Steel Mill. Frequently in the selection of a hoist the initial cost has a direct bearing on the final decision, they asserted. The cost of power often influences the style and type of hoist drive purchased. In a mine completely electrified the authors thought that a 1,000-hp. hoist motor had no appreciable effect on the demand charge when central-station power was purchased. They also demonstrated that complete electrification means greater production and lowest cost per ton of coal mined.

The straight induction motor, the water-rheostat control and the Ward

Leonard motor-generator system are the typical hoist drives, the paper said. The induction motor represents the lowest investment cost, but the starting demand is high. With the second system the demand peak is reduced about 15 per cent, while with the motor-generator set the demand peak is cut to one-half or one-third that of the induction motor, but the cost of equipment is about two and one-half times as much. As the energy consumed per ton of coal by the induction motor is always the same for the same installation, this system is more efficient when the output of the mine is cut down by slumps, car shortage, etc. With the motor-generator set the energy consumed is variable, depending on the rate of use.

Graham Bright of the Westinghouse Company declared that the cost of power should not be considered as very important when selecting drives. He claimed that with flywheel equipment the starting demand should be cut down a great deal more than the paper indicated. An animated discussion arose in regard to buying power from central stations as against private plants. Mr. Bright pointed out that usually water conditions made the private plant out of the question. G. W. Quentin of the Duquesne Light Company said that his company usually supplied mines from two separate sources and sometimes three. He recited a case where one mine supplied with central-station energy suffered a total interruption of only six minutes in one year and defied the advocates of the private plants to compete with this figure. H. Goodwin, Jr., of the Sanderson & Porter Company, told of a very large company with plants in several cities which bought all of its power. This company's opinion, based on actual experience, was that it was far more efficient to buy power because in a private plant the costs usually go up with age while with a central station the costs go down.

L. C. Mosley of the General Electric Company thought that the Ward Leonard equipment gives the most accurate speed control of mine hoists. He also showed how the drum shape of a hoist motor was a very important factor to contend with. This problem, he asserted, lends itself to a definite mathematical solution.

A. I. E. E. Summer Meeting

Engineering Progress to Be Celebrated in Diversified Papers at Swampscott Convention

NEW ENGLAND'S latchstring will hang outside the door for the American Institute of Electrical Engineers from June 25 to June 29, when the annual summer convention will be held at the New Ocean House, Swampscott, Mass., about 15 miles from Boston and on the famous North Shore of the Bay State. The local convention committee has been very active in its preparations and has organized an attractive program of work and play for visiting delegates and guests. Papers of large significance on both theoretical and practical phases of electrical activity will be presented. Local industrial plants, educational institutions and utilities are anticipating visits from the delegates, and trips to the numerous historic and scenic attractions of eastern Massachusetts will be made. There will be also an attractive program of sports. Headquarters will be at the New Ocean House, through which all reservations for accommodations should be made.

The keynote of the convention will be advances in equipment and plant design. Among the subjects to be covered will be modern developments in rectifiers, researches into the nature of insulation failures, artificial transmission lines, electric plants for commercial radio transmission and distribution, a new type of lightning arrester, lamp quality and street lighting, and a whole session will be devoted to the important subject of station economics as affected by the proposed use of 1,200-lb. steam pressure at the new Weymouth station of the Edison Electric Illuminating Company of Boston and by new methods of conducting away heat losses in generating machinery. Electric welding will be considered, and other papers which may be included in the schedule bear upon heat balance and plant economy, duplication of electrical equipment, instrument specifications and electrical instruments. At least one paper is planned expanding the ideas upon engineering education expressed at the Niagara Falls convention of the Institute in 1922.

In the main the afternoons will be devoted to the social and recreational sides of the convention, but if the program is crowded, one or two afternoon sessions may be held, as well as parallel sessions in the mornings.

Stock Issues Prominent in April Financing

NEW financing in April by electric light and power companies was less vigorous than in March, but exceeded the total reached in April, 1922, by more than twenty-two million dollars. Attention is called to the prominent part taken by preferred-stock issues, they totaling $11,643,800 out of the month's total of $65,718,800. Although long-term securities continued to predominate, several short-term offerings appeared during April. The rate of return yielded the investor advanced to 6.38, and the largest single issue was the thirty-million-dollar offering of gold bonds of the Illinois Power & Light Corporation. Refunding was less active.

SECURITY ISSUES OF ELECTRIC SERVICE COMPANIES IN APRIL

Name of Company	Amount of Issue	Period, Years	Class	Purpose	Interest Rate	Price	Per Cent Yield
Illinois Power & Light Corp.	$30,000,000	30	First and refunding mortgage gold bonds, series A	Refunding and to provide working capital	6	98½	6.10
Houghton County Electric Light Co. (Mich.)	225,000	4	First mortgage bonds	Refunding and to reduce floating debt	5	95	6.35
San Gorgonia Power Co. (Cal.)	400,000	1–24*	First mortgage serial gold bonds	Capital expenditures	7	100	7
Dominion Power & Transmission Co., Ltd. (Ont.)	†400,000	9	Gold bonds	Extensions	5	91⅓	6
Public Service Electric Power Co. (N. J.)	14,000,000	25	First mortgage sinking-fund gold bonds	Additions	6	97½	6.20
	6,000,000	....	Cumulative preferred stock	Construction	7	98¾	7.10
Portland Railway Light & Power Co. (Ore.)	2,000,000	24	First lien and refunding mortgage gold bonds, series B	Construction	6	94½	6.45
Central Maine Power Co.	600,000	3	Gold coupon notes	To reduce floating debt and for other purposes	6	99	6.38
Houston Lighting & Power Co. (Tex.)	2,000,000	30	First and refunding mortgage gold bonds, series A	To reimburse for expenditures and for other purposes	5	89½	5.75
Iowa Southern Utilities Co.	1,000,000	20	First and refunding mortgage gold bonds, series 1923	To reimburse for improvements and for other purposes	6	93	6.63
Sierra Pacific Electric Co. (Nev.)	1,643,800	....	Cumulative preferred stock	General corporate purposes	6	80 (ex. div.)	7.50
West Penn Power Co.	500,000	....	Cumulative preferred stock	Additions	7	100	7
Indiana Power Co.	1,000,000	....	Cumulative participating preferred stock	Additions	7	89	7.87
Long Island Lighting Co.	1,000,000	....	Cumulative preferred stock	Reimburse for expenditures	7	100	7
Middle West Power Co. (Ill.)	3,850,000	20	First mortgage gold bonds, series A	Reimburse for expenditures and for additions	6½	97½	6.75
Toledo Edison Co.	1,500,000	....	Preference stock, cumulative series A	Extensions	7	93⅓	7.50
Total	$65,718,800						

*Due serially Oct. 1, 1924-1947.

†Offered in March; not included in March tabulation.

Halts Flaming Gorge Plan

Federal Commission Also Imposes Delay for Flathead Lake—Pit River Permits Issued

THE determination of the Federal Power Commission not to act on the Girand license applies with equal force to other Colorado River projects. Despite the very urgent plea made by Utah interests and by the state itself, the commission has declined to take action on the preliminary permit asked by the Utah Power & Light Company covering its Flaming Gorge project. The permit is essential to the work of exploring foundations and to the preparation of plans. The demand for power in Utah is growing at such a rate that a delay in the development of Flaming Gorge may make necessary the erection of a steam plant at Salt Lake City, an alternative which is strongly opposed both on account of the higher rates which consumers would have to pay and because of the aggravation of the smoke problem which would follow the erection of a large power plant.

The Flathead Lake power project also is apparently enmeshed in delay and uncertainty comparable with the Colorado River situation. The staff of the commission urged at its April 23 meeting that the Rocky Mountain Power Company should receive a preliminary permit, abundantly safeguarded to protect the interests of the State of Washington, so that it could do the preliminary work necessary to the 270,000-hp. development planned at the outlet of the lake. The commission decided, however, to withhold action until the special commission appointed by the Secretary of the Interior to investigate the Columbia Basin plan should report.

PERMITS FOR PIT RIVER NOS. 3 AND 4

A preliminary permit has been granted by the commission to the Mount Shasta Power Corporation, a subsidiary of the Pacific Gas & Electric Company, covering two projects on the Pit River. The projects are known as No. 3 and No. 4. A license also was authorized in connection with the No. 3 project. The company has completed one project which does not come within the jurisdiction of the federal government. Ultimately it expects to complete five large developments on the river.

The commission has authorized a modification in the license issued the Southern California Edison Company for the project on Big Creek at the headwaters of the San Joaquin River. The company is rearranging its program so as to complete certain units five years earlier than was planned at first. This necessitates the elimination of one reservoir. Instead a diversion dam and an enlarged conduit are to be built to carry flood waters into another reservoir.

A license has been granted to the Molybdenum Corporation of America for the development of a small project on the Red River in New Mexico. The power is to be used for mining purposes.

Application has been made by the Knoxville Power & Light Company, an Electric Bond & Share Company property, for a preliminary permit covering the development of 200,000 hp. at four sites on the Clinch River. The application is in conflict with one from the Tennessee Hydro-Electric Company.

Additional time has been granted to the Niagara Falls Power Company for the installation of its new units, the commission having agreed to extend the time from May 1 to Dec. 31 for the installation of one of these units, while the date for the installation of the other two has been extended from March 1, 1924, to Sept. 1 of that year.

Water-Power Applications on Pacific Coast

Six applications for permits to appropriate water for power purposes were received by the Department of Public Works of the State of California during the month of March. The largest of the applications is that of Ray L. Allin, Sacramento, whose petition asks for a permit to appropriate 1,625 second-feet and 1,365,000 acre-feet per annum from Clear Lake and the North Fork of Cache Creek, all in Lake County. Mr. Allin proposes to develop 228,000 hp. and will construct 21 miles of conduit and 16 miles of pipe lines.

The Modesto Irrigation District has applied for a permit to appropriate 1,500 second-feet and 150,000 acre-feet per annum from the Tuolumne River in Stanislaus County. The district purposes to develop 17,000 hp. at an estimated cost of $360,000. The other applications are for small projects affecting only local areas.

During March the Division of Water Rights of the department issued three permits for the appropriation of water for power purposes. Roy H. Elliott, Hobart Building, San Francisco, has obtained a permit to appropriate 10,000 acre-feet per year from the North Yuba River in Yuba County. Mr. Elliott purposes to develop 20,682 hp. at an estimated cost of $1,500,000.

The Washington State Hydraulics Division recently received an application from Sterling B. Hill for a permit to divert 1,000 second-feet of water from the South Fork of the Nooksack River. Mr. Hill contemplates the erection of a large hydro-electric power plant and intends to spend in the neighborhood of $2,000,000. Mr. Hill has also made application for permission to divert 200 second-feet from Whatcom Creek, where he plans to erect a four-hundred-thousand-dollar hydro-electric plant. In addition to this the applicant intends to develop storage amounting to 65,000 acre-feet in Lake Whatcom. This water will also be used for power-generating purposes.

The Douglas Light & Power Company of Roseburg, Ore., has made application to the State of Oregon for a permit to appropriate 595 second-feet of water from the North Umqua River. The application asks for this amount of water for power purposes in addition to the 705 second-feet granted to the company under an old permit. The company plans to develop 2,289 hp. for light and power service in the adjacent territory.

Maryland Utility Merger Plans Are Announced

Plans are nearing completion for the formation of the Maryland Public Service Company, a new subsidiary of the American Water Works & Electric Company, which is to include the Potomac Public Service Company and the Cumberland Edison Company, both now controlled by the American company.

The plan calls for the issue of $3,893,000 of 6½ per cent bonds, of which $1,275,000 will be used to retire the outstanding bonds of the Cumberland Edison Company. The rest will be used in repayment of advances for new construction and other purposes by the American Water Works Company.

The rest of the capitalization of the Maryland Public Service Company will consist of $514,300 of 7 per cent preferred stock, which will be exchanged for a like amount of Cumberland Edison stock, and 25,000 shares of no-par-value common stock to be held by the parent company. A public hearing on the merger plans and finances will be held in Baltimore before the Maryland Public Service Commission.

Indiana Electric Utilities to Spend $50,000,000

New development work projected for this year or already under way by the electric light and power utility companies of Indiana will, it is estimated, entail an expenditure of $50,000,000, and the work planned, when completed, will place Indiana in the front rank of the states enjoying high-class utility service, according to Harry Reid of Indianapolis, president of the Indiana Electric Light Association and head of the Great Lakes Geographic Division of the National Electric Light Association, who added in a recent interview: "Indiana already has an investment of about $200 per capita in the public utility industry, which is about $40 per capita above the general state average."

Property additions, extensions of service, construction of transmission lines, building of power houses, connection of large populated areas, displacement of antiquated electrical equipment and expansion of generating facilities all form part of the year's new developments by Indiana light and power utilities. A large amount of this work centers in the Indianapolis area, although extensive construction programs are to be carried to completion in other of the larger cities of the state. Improvements and additions by the Indianapolis Light & Heat Company, planned prior to the explosion in the Mill Street plant two or three weeks ago, with the Terre Haute, Indianapolis & Eastern project and the Terre Haute

power development of the Central Indiana Power Company, are indicative of the general development of the electric power business, Mr. Reid said.

California Railroad Commission On Valuations

Figures showing the reductions made by the California Railroad Commission in the valuations of public utilities for rate-making purposes as compared with the valuations submitted by the utilities themselves, with a corresponding saving in rates to the people of the state, have been submitted by President Clyde L. Seavey of the commission to the Legislature.

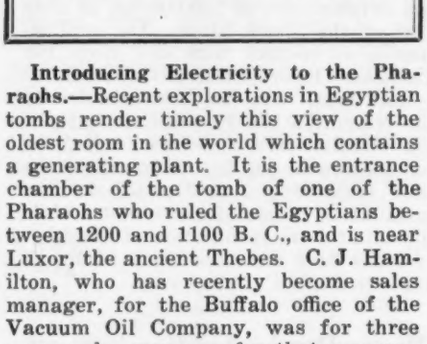
Reductions in the valuations of ten railroads and street railways, eight water companies, the Pacific Gas & Electric Company, the Southern Sierras Power Company, the Holton Power Company, the Western States Gas & Electric Company and the Great Western Power Company alone amounted to $128,922,688, with a corresponding saving in rates to the public of $10,227,000, according to the figures taken from the books of the commission. If rates as a whole had been augmented by even so slight an amount as 1 per cent, it would have added the sum of $4,000,000 to the amount paid by the ratepayers, the commission claims.

In the case of the Pacific Gas & Electric Company, the commission reports, the company claimed a valuation of $170,711,271 and the commission established a value of $109,723,695, a reduction of $60,987,576 and a saving to the ratepayers in one year of $4,800,000; in the case of the Southern Sierras Power Company and the Holton Power Company the companies claimed a valuation of $27,571,271 and the commission established a value of $14,026,126, a reduction of $13,545,145 and a saving to the ratepayers in one year of $1,080,000; in the case of the Western States Gas & Electric Company the company claimed a valuation of $8,793,063 and the commission established a value of $8,393,063, a reduction of $400,000 and a saving to the ratepayers in one year of $32,000, and in the case of the Great Western Power Company the company claimed a valuation of $69,516,725 and the commission established a value of $38,873,479, a reduction of $30,643,246 and a saving to the ratepayers in one year of $2,450,000.

The comparison between the transactions of the Railroad Commission in 1915 and in 1922 shows an increase of nearly 80 per cent. In 1915 the expenditures of the commission aggregated $349,235, while in 1922 they totaled $488,595, an increase of but 40 per cent. It is the object of the report submitted to the Legislature by President Seavey, he says, to place the facts clearly before that body so that the commission may be adequately provided with the funds necessary to continue its service to the people of California.

Brief News Notes

Introducing Electricity to the Pharaohs.—Recent explorations in Egyptian tombs render timely this view of the oldest room in the world which contains a generating plant. It is the entrance chamber of the tomb of one of the Pharaohs who ruled the Egyptians between 1200 and 1100 B. C., and is near Luxor, the ancient Thebes. C. J. Hamilton, who has recently become sales manager, for the Buffalo office of the Vacuum Oil Company, was for three years sales manager for that company in Egypt. Mr. Hamilton tells of a visit to this plant, which consists of a



British-built generator and an internal combustion engine and is used for lighting the various tombs of the ancient kings of Egypt which have been opened. It will probably supply electricity for the tomb of Tut-ankh-Amen next fall when it is opened for public inspection. A native engineer has charge of the outfit.

Arkansas Central Power Company Takes Over Little Rock Utility.—The Little Rock Railway & Electric Company has been absorbed by the Arkansas Central Power Company, just incorporated under the "no-par-value" act of the recent Legislature. Operation will continue under the same management. H. C. Abell of New York was elected chairman of the board of directors.

Chippewa May Take Over Central-Station Distributing System.—As a means of reducing light and power expenses both to the city and to individual consumers the City Commission of Chippewa, Wis., has under consideration the advisability of taking over the local electric distributing system of the Wisconsin-Minnesota Light & Power Company. At present the city cannot distribute electricity to private consumers. If the company will not consent to sell the plant to the city, it is said to be the plan of the municipality to institute condemnation proceedings.

Los Angeles Council Favors Survey of Utility with View to Condemnation Proceedings.—Following a bitter fight in the City Council of Los Angeles, an ordinance was passed recently authorizing an appropriation for a survey to fix the price of the electric distributing system of the Los Angeles Gas & Electric Corporation. The survey is being made by the California Railroad Commission for the purpose of clearing the way to start condemnation proceedings to acquire the property. Recently when the city ordered the survey the company commenced a suit on the ground that the commission had no authorization to spend money for that purpose.

Interstate Buys Four More Plants.—Officials of the Interstate Public Service Company of Indianapolis announced recently that the company had bought the properties and franchises of the Jeffersonville Water, Light & Heat Company and the plants at Francisville, Monon and Medaryville in Indiana. The company paid $250,000 for the Jeffersonville property and $90,000 for the other plants. It already owned the utilities in New Albany, a few miles from Jeffersonville. Energy for light and power for Francisville, Monon and Medaryville will be supplied by the plant of the Indiana Hydro-Electric Company near Monticello, which will be operated by the Interstate Company.

Insull Companies Buy More Coal Land. — The Commonwealth Edison Company of Chicago and the Public Service Company of Northern Illinois will be further protected in their coal supply by the organization of the Industrial Coal Company, which has acquired 6,200 acres of valuable coal lands in Franklin County, Ill., and two modern well-equipped mines already in operation. These coal properties will augment mines already owned by these companies. The Edison company will receive one-third of the output of the new company's mines and the Public Service company one-sixth. The Peabody Coal Company will receive one-half of the output.

Providence Utility Company Increases Facilities.—Dwight P. Robinson & Company, Inc., engineers and constructors, New York, have started work on the design and construction of the complete new switching plant which, as already announced, is to replace and extend the present facilities of the Narragansett Electric Lighting Company of Providence. The work includes a new four-story brick and concrete building and a smaller three-story extension to the present switch house. All power will be distributed from the new switching station to substations at 11,000 volts and 22,000 volts. In order to provide for future expansion all equipment will be designed for 22,000 volts.

Westinghouse War Memorial Scholarships. — The Westinghouse Electric & Manufacturing Company has announced that applications can be filed for its 1923 war memorial scholarships, open to employees of two years' continuous standing and not more than twenty-three years of age and to sons of

employees of five years' standing. Four scholarships are established annually by this company as a memorial to employees who served in the world war. Each scholarship carries with it an annual payment of $500 for a period not to exceed four years, such payment to be applied toward an engineering education in any technical school or college that the successful candidate may select with the approval of the committee.

New Water Power in Quebec.—Contracts for two important new water-power developments in the Province of Quebec have recently been let, says Consul E. H. Dennison in a report to the Department of Commerce, one of these being in connection with the rapids of the Grande Décharge of Lake St. John, while the other is a 15,000-hp. development on the Outarde River, on the north shore of the coast of that lake. It is predicted that within five years a minimum of 230,000 hp. will be developed at a cost of $12,000,000. There are said to be possibilities for developing 1,000,000 hp. from the stretch of rapids extending from Lake St. John to the head of navigation of the Saguenay.

Hearing on Revaluation of Alabama Power Company Under Way.—Revaluation of the properties of the Alabama Power Company, a matter which has been a football in Alabama politics for the last year, is provided for in an order issued recently by the Alabama Public Service Commission, and hearings started before the commission at Montgomery on May 1. The order for the revaluation is issued under the provisions of an act passed last February by the Legislature which authorized the commission to revalue public utilities in the state upon which valuations have already been fixed within three months after the approval of the act. The valuation made by the old commission, which went out of office in December, was attacked as too high and thereby permitting excessive rates to consumers.

Electric Vehicle Schools for Salesmen.—Under the direction of the Electric Truck and Car Bureau, supervised by the education committee of the Commercial National Section, N. E. L. A., two electric vehicle schools for salesmen are to be held in May and June—one in New York from May 15 to May 26 in the New York Edison Company building and the other in Chicago from June 19 to June 30 in the Commonwealth Edison Company building. The course of instruction will include transportation, engineering, trucks, motive equipment, batteries, garage equipment and operation, and truck operating and maintenance. The students will consist of representatives of electric light and power companies. Each school will be limited to fifty students, made up from the first fifty applications received. Only one application will be accepted from each company if a sufficient number from other companies apply to fill the class. There will be no charge for tuition. Applications should be made at once to E. S. Mansfield, chairman electric vehicle school committee, 39 Boylston Street, Boston.

Fayetteville to Have New Central Station.—A new power station for Fayetteville, N. C., to be constructed at a cost of approximately $750,000, has been announced by the Carolina Power & Light Company. The company has purchased 50 acres of land near a large manufacturing plant, and it is planned to erect the power station there. The power will be supplied from the Blewitt's Fall, Wateree and Yadkin River generating stations. To be used in cases of emergency, the company is also constructing a plant near Moncure, on Cape Fear River. This plant will supply cities in this territory with power in time of low water. More than a half million dollars has already been invested in the Fayetteville enterprise, according to a company representative. Work on the plant there will be started at once, and the company will be able to furnish the increased supply of energy immediately on the completion of the station and of a steel-tower line now being built from Laurinburg.

Associations and Societies

Electrical Supply Jobbers.—The regular quarterly meeting of the Pacific Division, Electrical Supply Jobbers' Association, will be held at the Hotel Del Monte, Del Monte, Cal., on May 10, 11 and 12.

National Association of Manufacturers.—Some of the pressing subjects to be discussed at the convention of this association in New York on May 14-16 are transportation, construction, production, the open shop, immigration, taxation and the merchant marine.

Chamber of Commerce to Take up Coal Problem.—A plea for solution of of the coal problem by economic rather than legislative means will mark the session of the natural resources group at the eleventh annual meeting of the Chamber of Commerce of the United States, to be held in New York on May 7-10. The group will devote its time to coal entirely.

Southwestern Public Service Association.—The nineteenth annual convention of this association, to be held at the Texas Hotel, Fort Worth, on May 15-17, will bring together for the first time in several years all the utilities in the Southwest. Among the speakers expected from outside the state are H. C. Abell of New York, chairman of the committee on public utility information bureaus, N. E. L. A.; Labert St. Clair of New York, W. H. Sawyer of St. Louis, H. T. Edgar of Boston and Oscar Fogg of New York. Special entertainment features have been provided.

Salt Lake Engineers Gather.—At the regular weekly "All Engineers" luncheon held at the Salt Lake City Chamber of Commerce on April 9 R. A. Hart, drainage engineer of the Department of Agriculture, who has recently returned from a trip to Hawaii, said that electrically operated pumps are rapidly replacing the old apparatus used for pumping in the irrigated districts of that territory, which comprise 80 per cent of the agricultural land. These weekly luncheons, held every Monday, are well attended, bringing the engineering fraternity of the city together.

Missouri Association Planning Program.—For the seventeenth annual convention of the Missouri Association of Public Utilities, which will be held on the steamer Harry G. Drees from May 24 to 26, sailing up the Mississippi and Illinois Rivers from St. Louis to Peoria and return, with frequent stops, a good program of papers and addresses is being arranged. The entertainment features will comprise dancing and golf on courses adjacent to the river. Since the boat will accommodate not more than 200 persons, reservations should be made as soon as possible with F. W. Beardslee, 721 Locust Street, St. Louis.

Coming Meetings of Electrical and Other Technical Societies

[A complete directory of electrical associations is published in the first issue of each volume. See Jan. 6 issue, page 78, for latest list.]

Nebraska Section, N. E. L. A.—Omaha, May 10-11. Horace M. Davis, Lincoln.
Southwestern Public Service Association—Fort Worth, Tex., May 15-17. E. N. Willis, 403 Slaughter Bldg., Dallas, Tex.
Empire State Gas and Electric Association, Electric Section—Utica, N. Y., May 17-18. C. H. B. Chapin, Grand Central Terminal, New York.
Electrical Supply Jobbers' Association—Executive committee and general meeting, Hot Springs, Va., May 21-25. Franklin Overbagh, 411 S. Clinton St., Chicago.
Missouri Association of Public Utilities—River boat from St. Louis to Peoria, May 24-26.
American Society of Mechanical Engineers—Montreal, May 28-31. C. W. Rice, 29 West 39th St., New York.
National Electric Light Association—New York, June 4-8. M. H. Aylesworth, 29 West 39th St., New York.
California State Association of Electrical Contractors and Dealers—Dorner Lake, Cal., June 9-16.
Electric Power Club—Hot Springs, Va., June 11-14. S. N. Clarkson, Kirby Bldg., Cleveland.
North Central Division, N. E. L. A.—Minneapolis, June 13-15. H. E. Young, Minneapolis General Electric Company.
Pacific Coast Electrical Association—San Francisco, June 19-22. S. H. Taylor, 527 Rialto Bldg., San Francisco.
Iowa Section, N. E. L. A.—Mason City, June 20-22.
Society for the Promotion of Engineering Education—Ithaca, N. Y., June 20-22. F. L. Bishop, University of Pittsburgh.
Canadian Electrical Association—Montreal, June 20-23. Louis Kon, 65 McGill College Ave., Montreal.
American Institute of Electrical Engineers—Annual convention, Swampscott, Mass., June 25-29; Pacific Coast convention, Del Monte, Cal., Oct. 2-5. F. L. Hutchinson, 33 West 39th St., New York.
American Society for Testing Materials—Atlantic City, June 25-29.
Associated Manufacturers of Electrical Supplies—New London, Conn., June 26-29. Frederic Nicholas, 30 East 42d St., New York.
National Council Lighting Fixture Manufacturers—Buffalo, June 26-28. C. H. Hofrichter, 233 Gordon Square Bldg., Cleveland.
Northwest Electric Light and Power Association—Seattle, June 27-30. G. E. Quinan, 204 Electric Bldg., Seattle.
Ohio Electric Light Association—Cedar Point, July 10-13. D. L. Gaskill, Greenville.
New England Division, N. E. L. A.—Swampscott, Mass., Sept. 6-8. Miss O. A. Bursiel, 149 Tremont St., Boston.

Recent Court Decisions

Interpretation of Utah's Watercourse Laws.—An attempted interpretation (in Caldwell vs. Erickson) of the phraseology referring to the authority of the State Engineer, "He shall have general administrative jurisdiction of the waters of the state," to mean waters owned by the state was overruled by the Utah Supreme Court, which held "of the state" in this instance clearly to mean the same as "in the state." (213 Pac. 182.)*

Telephone Company Liable for Damages Caused by Contact of Its Lines with Electric Light Wires.—Damages for loss from fire were confirmed against the Two States Telephone Company (plaintiff Hurley) by the Court of Civil Appeals of Texas, the court finding the company responsible because of the careless construction of its lines, which passed under the wires of the electric light company close to the building where the fire occurred and, it was alleged, came into contact with them, causing the fire. (248 S. W. 424.)

Burden of Proof on Party Claiming Right to Raise Dam.—Davenport vs. Centerville Water & Electric Company was a suit by landowners to enjoin the owner of a dam from raising water to a greater height than that to which it was raised by a former dam. The burden of proof was, the Supreme Court of Michigan held, on plaintiffs to establish by a preponderance of evidence that the crest of the dam, as limited by a decree of the trial court, was higher than that of the former dam. This evidence the Supreme Court did not find to be forthcoming. It added that a court may take judicial notice of wet and dry seasons which would affect the amount of water on lowlands. (192 N. W. 705.)

Damages Refused Because of Failure of Electric Service Company to Provide Surplus Water for Irrigation.—In Gause vs. Pacific Gas & Electric Company damages were sought because of the defendant's alleged failure to deliver water for irrigation purposes according to contract. In affirming judgment for the defendant, the California District Court of Appeal said: "The allegation of the breach of the water contract is insufficient. It is apparent that therein respondent agreed to furnish water upon certain conditions. It was expressly stipulated that it should first be used for the generation of electrical energy, which was declared to be its primary purpose. In fact, the fair interpretation of the covenants of the parties is that the company would furnish water if it had any left or was able to do so after using what was necessary for the development of the requisite electrical energy. That circumstance or contingency therefore became an inseparable part of the promise, and in order to state a cause of action it would be necessary to show that such water was not needed for that purpose. In view of the absence of any allegation to that effect, it will be presumed that respondent discontinued the delivery of the water for the reason that, in the opinion of its engineer, it was necessary to conserve it for the development of electric power." (212 Pac. 922.)

Failure to Warn Carpenter of Possible Danger from Escaping Currents Is Negligence.—In Jordan vs. Malden Electric Company damages were claimed because of the death of a carpenter who ascended to the roof of an electric power plant in company with the resident engineer and the foreman of the meter department to estimate on the work of building a projected platform, being plainly therefore lawfully upon the premises. The testimony tended to establish that he had not touched any of the equipment or wires, against doing which he had been warned, but had been killed by an arc-over from a lightning arrester near which he had been allowed to go. The Supreme Judicial Court of Massachusetts held that it could not be assumed as a matter of law that the victim knew or should have known of the peril in approaching the arrester and sustained the verdict for the plaintiff rendered in the trial court. (138 N. E. 536.)

Regulation of Sale of Power Imported from Another State.—In dismissing as "fragmentary and premature" an appeal of the Cannon Manufacturing Company and other cotton-mill operators against rates fixed by the North Carolina Corporation Commission for the Southern Power Company and remanding the case to the county court (see ELECTRICAL WORLD, March 3, page 533), the Supreme Court of North Carolina made observations to the following purport on the regulation of the sale of power imported from another state: Though the transportation into the state and sale of electrical energy therein directly to purchasers is interstate commerce, the regulation of the sale, including the fixing of rates at which it can be sold, is a matter within the power of the state where the sale is made, in the absence of any regulation by Congress. Evidence that a public utility whose rates were fixed by the Corporation Commission had made contracts with consumers in another state not affected by the decision, but that those contracts were made when the utility was first developing its plant and were less than the rates fixed by the commission within the state chiefly because the consumers thereunder took more power than those within the state, and that later contracts were at rates equal to those fixed by the commission, did not show that the rates fixed by the commission were unjust in contrast with the contract rates. (116 S. E. 178.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Commission Rulings

Flat Rates Obsolete—Street Lighting Service.—In authorizing new rates for the Fort Bragg Electric Company, the California Railroad Commission condemned flat rates as obsolete even in a small community and indorsed the meter rates which the company proposed to substitute. An electric utility, it said also, should own the entire street-lighting system except lamps and globes, which may be owned and maintained by the consumers. Rates for street lighting should be fixed on the basis of a fixed monthly charge varying with the size of lamp and number of annual burning hours.

Company Ordered to Serve Customers of Municipal Plant.—The Wisconsin Railroad Commission, on rehearing at the instance of the Lincoln Light Company, affirmed a previous order compelling that company to serve three extraterritorial customers of the Manitowoc municipal plant who, at the commission's instance, had been connected to the Lincoln Light Company's lines by the city, the line over which the city originally served them having been removed by a private individual who owned it. Under the commission's order the three customers thus served paid the legal rates to the city plus a rental charge of $6 a year each, and this revenue was turned over by the city to the company. The three customers were thus saved the expense of paying for connection. The company asked that these customers be placed upon the same footing as the other consumers whom it serves. (See ELECTRICAL WORLD, Sept. 23, 1922, page 683.)

Unprofitable Rural Extensions—A petition for an extension of electric service was denied by the Maine Public Utilities Commission in a case affecting the Cumberland County Power & Light Company on the ground that the extraordinary cost of rendering the service was so great and the resulting deficit would be so large that the company should not be required to make the extension without a guarantee of revenue approximating the cost of rendering the service. In the case at issue this was declared to be impracticable. The commission reiterated its view formerly expressed that rural service ought to be required whenever it can be given without placing an undue burden either on the company or on its other customers, even though the service must be rendered without profit; but it added: "If any particular section of the community is so situated by reason of its distance from the distribution line, its sparsely settled territory or any other reason that service to such community can be rendered only at additional or extraordinary cost, such additional or extraordinary cost must be borne by the particular community desiring the service."

Men of the Industry

Changes in Personnel
Accomplishments, Responsibilities, Honors, Appointments and Activities of Men
Engaged in all Branches of the Electrical Industry

Dr. Albert Hull Honored

Dr. Albert W. Hull, scientist in the research laboratory of the General Electric Company, has been awarded the Howard N. Potts gold medal for scientific research by the Franklin Institute, Philadelphia. The award was made for his studies in the crystalline structure of matter by means of X-rays and was based on a paper entitled "Crystal Structures of Common Elements" read before the Franklin Institute last year. Dr. Hull is also one of the foremost authorities on electron vacuum tubes and has been responsible for the development of some of the latest and most interesting types, such as the dynatron and magnetron, including a million-watt power tube. He has been active in the development of radio apparatus and last summer delivered a special course of lectures on X-rays and vacuum tubes at Columbia University.

The Potts medal was established in 1906 from a trust fund left by the will of H. N. Potts of Philadelphia. It is awarded only for "distinguished work in science or the mechanic arts."

Ferguson Heads New England N. E. L. A. Division

Samuel Ferguson, vice-president of the Hartford (Conn.) Electric Light Company, was elected president of the New England Divison of the National Electric Light Association last week at the annual meeting of the organization at Providence, R. I. Mr. Ferguson is a nationally known central-station executive and has been vice-president of the Hartford company for eleven years. For twelve years previous to his association with the Hartford Electric Light Company he was connected with the research laboratories of the General Electric Company at Schenectady. Mr. Ferguson was born in Exeter, N. H., in 1874 and is a graduate of Trinity College, Hartford. Other officers chosen were: Fred H. Smith, Worcester, Mass., vice-president; Miss O. A. Bursiel, Boston, Mass., secretary; G. M. Guilford, Boston, treasurer. The new officers will take up their work after the annual convention of the division at Swampscott, Mass., Sept. 6-8.

E. W. Rockafellow Joins National Pole Company

E. W. Rockafellow, known to all the industry as one of the elder statesmen of the electrical jobbing fraternity, has resigned from the Western Electric Company to become a vice-president of the National Pole Company in charge of sales. Mr. Rockafellow has been identified with the Western Electric Company since the very early days of the electrical industry, having grown up from office boy with that organization, and for many years he has borne the title of general supply sales manager. He has long been a prominent member of the Electrical Supply Jobbers' Association, and it will be exceedingly hard for electrical men to think of him as other than a jobber. As the Western Electric Company has been the principal distributor of the National Pole Company Mr. Rockafellow has long been in intimate association with the pole field, and he enters upon his new responsibilities with all the background of a pole man. He will have his office at 220 Broadway, New York.

A. B. West Receives Promotion

A. B. West, vice-president and general manager of the Southern Sierras Power Company and the Nevada California Electric Company, has been named president of the Southern Sierras Power Company, to succeed the late Guilford S. Wood of Denver. After his graduation from Stanford University in 1899 Mr. West became junior member of the law firm of Potter & West in Denver. At that time this firm was acting as general counsel for the Nevada-California Power Company, and when the power company decided to enter the southern California field Mr. West was transferred to the operating end of the business and made vice-president and assistant to the president. During his association with the company it has experienced a remarkable growth and has been an important factor in the development of the southern part of California. He has been active in the Pacific Coast Electrical Association, having at one time served as its president. Fred O. Dolson, general superintendent, and E. B. Criddle, general agent, of the Southern Sierras Power Company were made vice-presidents of the company at the time of Mr. West's election to the presidency.

A. B. WEST

Th. G. Holmboe, editor *Teknisk Ukeblad*, Christiania, Norway, is in the United States on an eight weeks' visit, studying American engineering practice.

Obituary

Floyd Charles Furlow, president of the Otis Elevator Company, died on April 26 at the Ritz-Carlton Hotel, New York, after an illness of six weeks. Mr. Furlow was educated at the Georgia Institute of Technology and later, while pursuing the profession of consulting engineer at Atlanta, lectured in experimental engineering there. He became chief engineer for the Otis Elevator Company in 1905, and soon after was made vice-president and then president. Mr. Furlow, in spite of his business activity, did extensive research work in electrical, hydraulic, and steam engineering and machine design.

Frank E. Russell, general manager of the Tucson (Ariz.) Gas, Electric Light & Power Company, died at his home in that city on April 15, at the age of sixty years. Mr. Russell suffered a breakdown in health in July, 1922, being taken with a severe attack of sciatic rheumatism, which finally developed into pneumonia, from which a complication of diseases resulted. Mr. Russell began his public utility career with the Western Union Telegraph Company, subsequently becoming active in the organization of the Tucson Gas, Electric Light & Power Company during the year 1892. Shortly after this he was appointed general manager, and he continued in that office until his death, a period of more than thirty-one years. In 1910 the Tucson company became a unit of the Federal Light & Traction Company of New York.

Eugene Carpenter, a pioneer New England central-station man, died on April 25 at the age of fifty-five. Mr. Carpenter was a native of Rowe, Mass., and among his earlier activities was the building of the central station at Gardner, Mass., and the pioneer three-phase hydro-electric installation for transmission of energy from Sewall's Falls to Concord, N. H. After engaging in construction work and subsequently in selling he became interested in the central-station properties on Martha's Vineyard and Cape Cod, developing these under the organization of the Boston Electric Associates, which also built up a number of small utility plants in the interior of Massachusetts and New Hampshire. Under Mr. Carpenter's guidance the Cape and Vineyard properties flourished, and to him more than to any other is due the development of electrical service in the sparsely settled area east and south of the Cape Cod Canal. He was active in the New England division of the N. E. L. A. and contributed much to its convention discussions.

Manufacturing and Markets

Devoted to the Discussion of Business and Economic Problems of the Producer and Distributor, with Market Reports, Trade Activities, Foreign and Construction News

Our Appliance Market—What It Needs*

Sales Now Falling Behind Increase in Houses Connected—Four Fundamentals That Must Be Organized Into Our Selling

By Martin L. Pierce
Research and Promotion Manager Hoover Suction Sweeper Company
North Canton, Ohio

WE HAVE in the United States today approximately 8,500,000 homes wired for electricity. The normal increase of resident meters is 12½ per cent per year. During the investigations which I have made in the last few months I have not found a single community in which there are as many home demonstrations being made week by week for the three major appliances—washers, ironers and sweepers—as there are new home meters being connected. Of course, there may be such communities, but in my investigation I have failed to find one. In many of the larger cities, such as Cleveland, Ohio, I found that the home demonstrations did not equal more than 50 per cent of the new homes being electrified.

In other words, the merchandising of appliances is running approximately 50 per cent behind the electric development. The time has come when the electrical industry should establish for itself a definite sales responsibility for electric appliances.

What the Market Is

The electrical industry has been too modest in the past, both in its demands and in its expectation regarding the average investment of the typical home owner. While the plumber has been getting from 13 per cent to 15 per cent of the cost price of the average home or apartment, the electrical dealer has, for the most part, been satisfied to get from 1 per cent to 3 per cent. There is certainly no reason, however, why the electric industry should not be obtaining from the home owner an investment for electrical equipment that will at least equal that obtained by the plumber.

The electrical industry in California, after a very thorough analysis, has come to the conclusion that every household should spend as much for electrical equipment as it spends for its automobile. The industry feels that the time has come for the installation of complete electrical equipment, and it is making a concerted drive for the realization of that end.

Recent investigation showed that for every ten wired homes in the United States there are nine automobiles, there are nine talking machines, but there are only one and a half electric cleaners and only one electric washing machine. Shall we not establish for ourselves a program that will comprehend the selling of as many of the major appliances as there are automobiles and talking machines in any given community?

Turnover Means Profit

To reach this possible market for electrical appliances the industry should universally make use of modern merchandising ideas and methods.

Above all else, these four things should be done:

First—The advertising of the industry should be built on facts, not "hunches." For instance, a Western central-station company operating in about thirty towns began a campaign on washing machines. These were advertised extensively in the newspapers. Their basic appeal was that of economy. The campaign did not go over. A washing machine was offered as a prize for the woman who would send in the best reason why a woman should have a washing machine. More than two thousand replies were received, and these are the reasons according to the women themselves: Thirty per cent wanted the machine because it saved time, twenty-five per cent because it saved strength, 14 per cent because it saved health, 12 per cent because it preserved youth and beauty, 8 per cent because it was more economical and 7 per cent because it contributed happiness to the home. The advertising campaign was changed to conform to the information gained from these prospective customers, and sales went over with a bang.

Second—The industry must appreciate the fact also that profit comes from turnover, not mark-up. The merchandising manager faces two kinds of expense, selling expense and carrying charge. In the large dry-goods store and the small department store, for example, the selling expense is 4 per cent and the carrying expense 20 per cent. An upholstered chair that cost $100 and is marked up 50 per cent would sell at $150. If the chair were sold the day it was put on the floor, there would be no expense except for selling, which would be $6. The firm would actually have made $44. If it remains on the floor for a year, it will have charged against it $5.25 for rent, $9 for supervision, $4.50 for advertising, $1.50 for heat and light, $1.80 for delivery, $1.80 for insurance and taxes, $3.75 for general expense and $2.40 for depreciation and bad debts.

If at the end of the year the chair is sold for $150, the firm does not make $44 profit, but $44 less $30, which is 20 per cent of $150, or $14. If the chair should remain in stock for two years and the firm should still sell it for a 50 per cent mark-up, the firm would actually lose $16. The small additional discount secured by buying in large quantities seldom equals the carrying charge that must be subtracted from the gross profit.

Standard Costs Needed

Third—Standard costs for doing business must be worked out and adopted if the business is to be established on the high plane of prosperity that must be achieved if the job is to be done. At a recent dinner in Canada I sat between two merchandising managers, each in charge

*From a paper read before the convention of the Southwestern Geographic Division, N. E. L. A., Oklahoma City, March 14-16, 1923.

of an electrical department. One of them told me that the overhead charge against his department is 15 per cent. The other man told me that it was 22 per cent, and yet they were both doing business in the same town and under practically the same conditions. The indications were that possibly neither of them knew what the actual overhead charges should be. If either one did know them, the other was being discriminated against. The facts are that the electrical industry, to be successful in merchandising appliances, must be willing to adopt standard costs of doing business.

The costs of hardware stores, dry goods stores and department stores are no longer experiments. These retail firms are actually making money and some of them accumulating millions in reserve on the store costs that have been adopted. In 1921, 366 department stores doing $600,000,000 worth of business did it on an average gross mark-up of 28 per cent. Their net profit on this volume of business was 1.9 per cent. Millions of profits were accumulated because the stock was turned seven or more times on an average. This 1.9 per cent did not take into account the profit made from cash discounts.

Fourth—Our merchandising drive should be set up for twelve months in the year. There was a time when the electrical industry thought that appliances, such as cleaners, could not be successfully sold except at house-cleaning time.. We have learned, nevertheless, that there is no closed season for the selling of appliances.

A Southern central-station company recently put on a special campaign for electric ranges in the winter and sold more than it had ever sold during the same time in the middle of the summer. There are just as many sales arguments for electric cleaners, table appliances, washing machines and electric ranges for winter as there are for summer use.

Every industry that prospers has an ultimate ideal, an aim that cannot be realized in a year and possibly not in a century. With us it is without question the servantless home made possible through the development and use of public utilities. The appliance industry should plan to enter in 100 per cent to bring about the elimination of housekeeping drudgery in every American home.

Contractors in Cut-Throat Competition

Owners of Buildings Under Construction Should Have Some Protection in Inspection—Guiding Cost Statistics Are Greatly Needed

BY A MANUFACTURER

I AM WONDERING whether in all our talk about cut-throat competition among contractors we know just what we mean. Most of us probably have in mind the fact that there are a vast number of "chip-basket contractors" who lack all practical knowledge of the rudiments of business and therefore carry on a destructive strife for jobs among themselves. The contractor must be educated, we say, so that he will do "quality" work for a good price and be prosperous. But, as a matter of fact, I believe that our biggest, most educated contractors are probably practicing the worst cut-throat competition in the whole game.

In my opinion, the most conspicuous cut-throat competition that the business is cursed with today comes from the "silk-stocking," college-bred electrical contractor, who terms himself an "engineering contractor" and claims that he has to practice the cut-throat variety of competition to stay in business. How is it done? There are two ways most popular. Poor-quality materials are substituted for those which are specified. That is one method. The other is to bid down the price of the job and then build it up on extras made possible by changing details in the job to differ from the specifications.

SELLING DOWN THE JOB

I have been disappointed, discouraged and disgusted with some of the owners, and even the architects with whom we have got into touch, who have taken the word of some of these large cut-throat contractors as gospel truth and allowed themselves to accept material that was absolutely not in any way up to the standard of the specifications. There has been an epidemic of substituting the cheapest of material in the cheapest method of installation in the past two years, and we are not over it yet. I remember some time ago an engineer telling us how he had actually "sold" the owner on the idea that his job was worth $12,000, and behold, the job was let to a contractor of standing for $7,800. The engineer himself said, "How can they do it?" I suppose by this time he has found out that they substituted in every line of material and "skinned" the job down in workmanship.

As to the "chip-basket" contractor, nobody has ever given him even the credit of having business ability, and naturally when the owner and architect call him in because his price is 20 to 30 per cent lower than that of other contractors and tell him that their appropriation necessitates cutting the electric work still another 20 or 30 per cent, he takes it for granted that they mean exactly what they say, and he proceeds to "skin" the job some more and still further reduce its value.

INSPECTION IGNORES SPECIFICATIONS

The result is that, regardless of what is shown or called for on the plans and specifications for a job, the inspection is not based on it. The inspection ordinance in no way recognizes the architects or owners or the engineer's plans and specifications as the basis of an inspection, but instead calls for the contractor to submit a list of the outlets and lights for which he is wiring. That, of course, means the skinned-down job that he has made his price on, so that he can well afford to do the job well for the outlets and capacities of switches that he figured on, and naturally the inspection will give him a clear bill of health and a wonderfully valuable certificate of inspection, which in no way recognizes the capacity or conditions that were called for under the plans of specifications.

EDUCATION NEEDED

Now as to the remedy. In the first place, we must educate the architect and engineer and the owner to recognize that there is a classification of value among contractors just as there is in dry-goods stores or any other line of business; that there are some contractors who have the reputation of being cheap, and there are others that have a reputation for responsibility and good installations. It is not fair to have both of these figure on the same job. If the owner wants a good job, he should get a first-class, reputable con-

tractor. If he wants a cheap job, he should not call on the good contractors, but get a man who puts in cheap work. He should know that the price regulates what he is going to get on the job, and, furthermore, he must understand that the inspection is simply on the work as installed.

GUIDING STATISTICS NEEDED

Moreover, the electrical industry could well inform the owner, architect and engineer as to the proper cost of the electric work as compared with the cost of the entire building. Let us tell them what a less-than-average installation should cost, an average installation and a better than average installation, and advertise this broadly so that the owner and architect and the engineer will have something fundamental with which to compare their bids. The "quality" contractor could use it as an argument that the statistics of the industry prove that his bid is within reason for a less-than-average or better-than-average job.

I have followed up the residential wiring in one city for a number of years and know of electrical work in jobs running $15,000 and under that ran only from three-tenths to five-tenths of 1 per cent. Just consider the crime of such an installation! On the other hand, I know that where the contract was let to reliable contractors, it began to run up into 2, 3 and 5 per cent, and we have done a number of jobs that ran as high as 7 and 8 per cent. Of course, these could be classed as better than average.

As a matter of fact, I have been told several times by architects that they have quit trying to figure on what the electrical work will cost, because they know it will always be cheap enough anyway. That's a fine reputation for the electrical business.

Business Conditions

A Survey of Important Developments in the Electrical Market Including Data on Production, the Sales Outlook, Credits, Exports, the Metals and Other Conditions Affecting Cost, Supply and Demand

TRADE continues vigorous, with well-sustained volume, although the demand upon jobbers last week was decidedly spotty as regards the geographical distribution of orders. Improved transportation conditions are making it easier for distributors to serve their customers, but in most lines the trend of deliveries out of the factory is toward longer datings after receipt of orders. Little complaint of shortages was heard the first of the week, although it is virtually impossible for jobbers to build up stocks in the face of the present demand.

Few price changes of importance were announced last week, the trend being upward in general with firm maintenance of quotations issued in the latest sheets to sales representatives. The upward pressure of labor toward higher wage levels continues, combined with a distinct scarcity of workers in many lines. Prices of Western red cedar poles, 30 ft. with 8-in. top to 90 ft., increased approximately 10 per cent in the early part of the week.

General business is unabated in volume. Building contracts in New England for the latest reported week totaled $8,858,600 against $12,924,400 a year ago, but the former figure exceeds all other corresponding weeks for twenty years. Rubber, textile, metal-working and paper industries are almost overwhelmed with orders. Central-station new-business departments are taking on extensive additional loads, house wiring is running at "full blast," and electrical apparatus manufacturers are working well up toward plant capacity in most lines. Here and there the reconstruction of distribution lines will be necessary as a result of flood conditions on interior rivers, and important interconnections and plant construction for utilities are keeping engineers and sales forces busy. Large telephone and railroad equipment and reconstruction budgets are announced for this section.

General Business Shows Continued Gain

IN A review of general business and financial conditions the Federal Reserve Board says further increases in production of basic commodities, wholesale prices, employment, wage rates and wholesale and retail trade took place in March.

The board reported, however, that during the month prior to April 11 a more moderate growth in the demand for credit for member banks in leading cities resulted in an increase of about $48,000,000 in their loans, made largely for commercial purposes, as compared with an increase of $235,000,000 in the preceding month.

"Through withdrawal of funds from investments and a further inflow of gold," the board says, "member banks have been able to meet demands of their customers for increased credit and currency independently of the reserve banks. Consequently, the total volume of Federal Reserve Bank credit, measured by the total earning assets, has remained relatively constant during the last month and, in fact, since the seasonal liquidation at the turn of the year."

Production in basic industries, according to the board's index, increased 4 per cent in March to a level 8 per cent higher than at the 1920 peak and 67 per cent above the low point of 1921.

The output of pig iron, steel ingots, automobiles and crude petroleum and the mill consumption of cotton exceeded all previously reported monthly totals.

Building operations showed a further large expansion and the value of contracts let for residences in March was the highest on record. Railroad freight shipments have been larger every week this year than in the corresponding weeks of the last four years. Car shortage has been reduced to the lowest point since September, chiefly as the result of the addition of new equipment, a decrease in the number of locomotives and cars in bad order and a concerted effort to increase the average loadings.

Case Involving Right to Exchange Trade Information

ARGUMENTS were presented April 25 and 26 before the United States Supreme Court in the case of the government against the American Linseed Oil Company and others, involving the right of business to exchange trade information through associations or through private bureaus acting as clearing houses for such data. The case is considered to be the most important to all trade associations since the hardwood-lumber case, but it involves different questions from those presented in the latter.

The federal government alleged that by exchanging various forms of information which was distributed as statistics by the Armstrong Bureau of Related Industries the defendant linseed-oil companies created a condition tending to prevent competition in prices of their product. The United States District Court for Northern Illinois, where the suit originally was instituted in 1921, held for the defendants and ordered the suit dismissed, the Government appealing.

In arguing before the Supreme Court, Special Assistant Attorney General James A. Fowler declared that daily and instantaneous price reports were sent the bureau by the linseed-oil members and relayed back to the members by the bureau, charging that each day each member knew the prices quoted by his competitors.

Thomas M. Debevoise appeared as attorney for the American Linseed Oil Company and John Walsh, formerly chief counsel for the Federal Trade Commission, appeared in behalf of the Armstrong bureau and other defendants. They argued that while various statistical information was exchanged through the bureau, there was no restriction of output and no combination or agreement as to price. Prices of the oil followed the flaxseed market, they

argued. The right of business corporations to compile statistics on which to base judgment was upheld, they contended, by the fact that the Department of Commerce gathers and distributes statistics of business.

Says Promotion Work Is Needed to Get Business in Porto Rico

A MUCH larger volume of electrical equipment could be sold in Porto Rico were American salesmen sent to that island with the idea of doing some promotion work. Porto Rico already is a large customer and knows American electrical goods. The central stations on the island are efficient and progressive. The San Juan Railway, Light & Power Company has made active use of the demonstration idea, but much of the business in electrical equipment simply has gravitated to American markets. Very little effort has been expended by American manufacturers or jobbers in increasing the amount of electrical goods which the country will absorb.

To all intents and purposes Porto Rico is domestic territory. There are no duties on imports from the United States. The rather high internal-revenue taxes which are levied on many articles of luxury have not been applied to electrical accessories. These are observations made by R. A. Lundquist, chief of the electrical equipment division of the Department of Commerce, who has just returned from a visit to the island.

Twenty-three out of the thirty-five sugar centrals on the island are electrified. The present price of sugar is encouraging the owners of the remaining mills to consider electrification.

Additional hydro-electric development is certain to come. To be handled to greatest advantage, however, all of the water powers on the island should feed into a single system. The island is 100 miles long and 35 miles wide. Conditions are ideal for meeting the power requirements of the entire island with energy which is produced hydro-electrically.

Chicago Business Active with Advancing Prices

BUSINESS in Chicago electrical circles still remains active. The most important announcements this week are an advance in conduit and switches and a reduction in the list price of incandescent lamps. Conduit advanced three points. Service entrance switches, externally operated, three-pole, advanced 2 per cent, two-pole 5 per cent, slate fuse blocks 10 per cent, single-pole slate fuse blocks 4 per cent, type C switches 6 per cent and snap switches have advanced 3 per cent.

There has been an approximate reduction of 10 per cent on the entire line of incandescent lamps, the reduction being from 2 cents to 25 cents per bulb on the entire line. This is the first reduction of the entire line in several years. Pole-line hardware demand is extremely active since numerous large orders have been placed for this material during the week. High-tension-equipment sales still remain up to their previous standard.

The demand for flatirons has been very good, and it is the belief that no increase in price of this commodity will occur for some time, inasmuch as irons are highly competitive. While initial orders are being placed for distributors' requirements of fans, the demand has not yet started on this class of material. Prices are firm. Storage batteries are holding their own, with no increase anticipated at this time.

Motor Demand Well Sustained; Prices Expected to Increase

TAKING the country as a whole, the demand for motors of moderate size continues active, taxing current manufacturing facilities close to capacity. There is no present sign of a lower volume of business, but in some circles the curve of increased sales is expected to swing toward a smaller angle against time within a few months. In other words, there is some doubt if the present rate of sales gains can be sustained indefinitely.

Prices are firm and some advance appears almost inevitable if the cost of materials and current wage scales continue to stiffen. Not all the small-motor business of recent months is believed to have been booked at a satisfactory profit, some orders having been taken at figures chiefly attractive from the standpoint of keeping plants well occupied. There appears to be no general tendency to enlarge motor factories unduly against a heavy increase in business, and this conservative policy is reflected in present deliveries.

Range Sales Improving as Season Develops

STEADY improvement in range sales continues as the season develops. Raw-material shortage is less troublesome, and some reserve capacity in plant facilities exists to meet an expanded demand. At present no serious labor shortage is reported in this branch of electrical manufacturing. Development work is making good progress toward the early marketing of a new moderate-priced range by a representative manufacturer, which will probably retail in the vicinity of $100. Central-station rates are being formed with closer regard to the commercial exploitation of ranges, and the outlook is good for the next few months' sales.

The Metal Market

The extreme dullness which has characterized the metal markets in recent weeks continues in even more accentuated form, with no buying of consequence in any metal. That producers are feeling this lack of demand is indicated by further price reductions, though there is no disposition to force large tonnages on an unwilling market, and most producers are well sold up with current production. The lowering of prices would probably not amount to much were it not for the fact that prices have dropped considerably in London. The increased unwillingness to buy on the part of local consumers is without doubt caused by the feeling that prices are tending downward rather than up and that no more metal should be booked than is necessary for the needs of the immediate future.

Very few buyers have been interested in the offerings of producers, even at slight reductions in price. The larger interests are generally asking 17 cents delivered, but this price is admittedly a nominal one. A little copper was sold last week at 16⅞ cents delivered, and an occasional carload brought even as much as 17 cents, but later offers at these prices brought no response whatever. A fair tonnage was sold at 16.75 cents, largely for June and July delivery.

NEW YORK METAL MARKET PRICES

	April 25, 1923 Cents per Pound	May 2, 1923 Cents per Pound
Copper, Electrolytic	17.00	16.75 to 17.00
Lead, Am. S. & R. price	8.25	8.00
Antimony	8.37½	8.00 to 8.25
Nickel, ingot	28.00–30.00	28.00 to 30.00
Zinc, spot	7.37½	7.37½
Tin, Straits	46.62½	45.00
Aluminum, 98 to 99 per cent.	26.00	26.00

The export market showed some signs of life last week, owing to favorable fluctuations in exchange, but it is again very weak. Sales during the week have netted producers on this side about 17⅛ cents for most of the business that has been done.

The official contract price of the American Smelting & Refining Company was reduced from 8.25 cents, New York, to 8 cents. This is the first reduction that has been made since June 22, 1921, when the price was established at 4.40 cents. The reduction was caused by the factors mentioned last week, namely, the decline in import costs, and the fact that lead was being offered by others at the 8-cent level.

Comparative Prices of Station Supplies

	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars, per lb.	$0.0326	$0.0322	$0.0236
Cold finished shafting, per lb.	0.0406	0.0406	0.032
Brass rods, per lb.	0.1913	0.1904	0.15
Solder (half and half), per lb.	0.2987	0.314	0.21
Cotton waste, per lb.	0.1231	0.1231	0.104
Washers, cast iron (⅛-in.), per 100 lb.	4.66	4.50	4.00
Emery, disks, cloth, No. 1, 6-in. diameter, per 100	2.96	2.96	3.11
Machine oil, per gal.	0.349	0.349	0.40
Belting, leather, medium, off list	42%	42%	48⅓%
Machine bolts, up to 1-in. x 30-in., off list	44⅓%	48⅓%	62⅓%

Activities of the Trade

Devoted to News of the
Manufacturer, Jobber, Agent, Contractor and Dealer, Including Important Orders and Contracts for Apparatus and Equipment

Landers, Frary & Clark Announce Window-Display Contest

Announcement is made of the "Universal" electric iron window-display contest and national advertising campaign by Landers, Frary & Clark, New Britain, Conn.

Twelve cash prizes are offered for the twelve best window displays. The first prize is $100. The contest closes June 30 and is limited to dealers who have the company's "Universal" irons in stock or who had ordered them at the time this contest was first announced.

Every week for six consecutive weeks "Universal" advertisements will appear throughout the United States in more than fifty big metropolitan newspapers, reaching millions of people each issue.

Century Electric to Reconstruct Six-Story Factory

The Century Electric Company, St. Louis, manufacturer of motors, has just contracted for the reconstruction of the six-story factory building at the southwest corner of Eighteenth and Pine Streets. The building adjoins the six-story building recently completed by this company on the south side of Pine Street opposite its main factory on the north side of Pine Street. A spacious tunnel has been constructed under Pine Street connecting the two factories on the opposite sides of the street.

The building to be reconstructed was built forty or fifty years ago as a carriage factory. With this addition the Century Electric Company will have a six-story factory on the south side of Pine Street, almost a block long. The additional building was made necessary by the tremendous increase in the Century company's business. Plans for the reconstruction work were prepared by L. Bayton Pendleton, architect, who will have entire supervision of the work.

Commercial Truck Company Receives Order for 177 "Electrics"

The Commercial Truck Company, New York City, has received an order for 177 one-ton electric delivery wagons from the Wagner Pastry Company of Newark, N. J. This is one of the largest electric truck orders placed at one time.

Engineers of the Commercial Truck Company anticipate a saving to the pastry company of $100,000 a year at the Newark plant, where these "electrics" will replace an equal number of gasoline trucks and wagons. Before placing the order the company experimented on all of its seventy routes for a year.

The Commercial Truck Company has opened up a new garage at 542 East Nineteenth Street, New York City.

E. W. Bliss Moves Sales Offices to South Brooklyn Plant

The E. W. Bliss Company, Brooklyn, N. Y., manufacturer of machinery, has moved its sales and executive offices to its South Brooklyn plant, at the foot of Fifty-third Street, on the east shore of the upper New York bay. This plant comprises a group of seventeen buildings covering a ground area of 18 acres and has a total floor area of 21 acres. It has a water frontage of 390 ft., on which there are two piers, one being 200 ft. long and 80 ft. wide and the other 575 ft. long and 60 ft. wide. There is ample water to accommodate the average-size steamship.

During the war many large additions were made to this plant to meet war requirements until it reached its present large proportions. At the termination of the hostilities a very considerable amount of space and equipment was available.

The Bliss company determined that consolidation of its two Brooklyn plants had decided advantages, and accordingly it has moved practically all the machine equipment from the Adams Street plant to the South Brooklyn plant, using the space made available by the dismantling of the special machinery which was necessary for war requirements.

Apex Company's New Appointments

The Apex Electrical Distributing Company, Cleveland, home appliances, announces that Albert E. Richter, who has been Northwestern district sales manager of the company, with headquarters in Minneapolis, has been called back to the Cleveland factory as sales promotion manager. B. D. Schock, who formerly was Mr. Richter's assistant, has been appointed sales manager of the Northwestern district.

Pure Carbon New Representative

Announcement is made by the Pure Carbon Company, Wellsville, N. Y., manufacturer of carbon motor brushes, of the recent establishment of a Minneapolis representative, the Charles A. Etem Company, 917-A Marquette Avenue.

Anaconda's 1922 Business Was Largest in Its History

The Anaconda Copper Mining Company, for the year ended Dec. 31, 1922, reports gross revenue of $175,450,384, the largest for any year in the history of the company. The increase, however, was due to the acquisition of the properties of the American Brass Company in the early part of 1922. The total of $175,450,384 compares with a total of $33,113,231 in 1921. After payment of all operating expenses and reserves for federal taxes, the company reports net operating income of $11,432,044, against a net operating deficit of $6,257,042 the year before.

After providing for reserves for depreciation, bond interest and writing off of loss in connection with suspended mining operations during the first quarter of the year, the company reports a balance of $3,539,239 available for the 3,000,000 shares outstanding of capital stock of $50 a share par value, or the equivalent of almost $1.18 a share. In 1921, after all deductions for interest, reserves and other charges, the company reported a deficit of $17,061,189.

National Carbon Sales Manager Praises Dealers as Stabilizers

James R. Crawford, general sales manager of the National Carbon Company, New York City, gave out the following interview during the recent joint convention of the Southern Hardware Jobbers' and the American Hardware Manufacturers' Association at Jacksonville, Fla.

"It is little short of marvelous," says Mr. Crawford, "the way in which the United States has recovered its stride after the disrupting march of the war. All of the dire predictions of the pessimists in regard to the difficulties we should experience in reabsorbing into our industrial life the great mass of discharged soldiers have proved false. All the wild and disquieting talk about the dangers of bolshevism and the spread of radical doctrines has likewise been shown to have had no foundation in fact.

"Particularly remarkable and gratifying is the brave 'comeback' from industrial depression that the South has made. I doubt if at any previous period the agricultural prospects of the Southern States were so promising. Aided by vast acreage reclaimed by draining and by intensive and scientific study of the soils, the Southern farmer and fruit grower is filling an ever larger space in the markets of the world. In industry also, especially in cotton weaving and kindred arts, the Southern States have entered into keen and healthy competition with the New England States. I am glad to note that Southern industries as well as those in other parts of the nation have apparently learned and taken to heart the lesson as to the value of advertising in the daily press. Very fine

barometers of business are the advertising columns of the daily paper, which, after all, is the best advertising medium in the world when backed up by the proper advertising to the jobber, wholesaler and retailer in the business trade press.

"One of the chief factors in bringing business back to normal has been the retail dealer. By co-operating with the jobber and manufacturer, the utilization of the most modern merchandising methods, the use of newspaper advertising, window displays and other advertising material, and by teaching his clerks salesmanship, he has speeded the wheels of commerce and aided in the task of re-establishing prosperity.

"Only a country as resilient, quick to sense new value and grasp new opportunities, a country with a spirit large enough to march alongside the splendid opportunities America offers, could have got back into a steady business step as quickly as our country has done. There has been no gulf created between capital and labor; instead there is a growing realization that the interests of capital and labor, so far from being opposed, are identical. Fearing a great influx of cheap labor from the distraught countries of Europe, our Congress passed a selective immigration law designed to keep our own American workmen from being swamped by cheap competition. Really such a law may not have been needed at all, for business and industry have taken on such sturdy, new vitality that there is actually a shortage of labor and there is no excuse for a man being without a job at good wages."

Westinghouse Lamp Prices Cut

The Westinghouse Lamp Company, simultaneously with other lamp manufacturers, announces a reduction in prices of lamps amounting to from 8 to 10 per cent.

Allis-Chalmers Sales in First Quarter Were $5,221,691

Sales billed by the Allis-Chalmers Manufacturing Company, Inc., Milwaukee, manufacturer of electrical machinery, amounted to $5,221,691.78 during the first quarter of 1923, with net profit of $468,689.62 after provision for federal taxes was made.

	Sales Billed	Net Profit After Provision for Federal Taxes
January	$1,616,955.28	$123,479.17
February	1,727,414.91	156,711.47
March	1,877,321.59	188,498.98
	$5,221,691.78	$468,689.62

G. E. Turbine Generator Order

The General Electric Company has just received a contract for a 60,000-kw. cross-compound steam-turbine generator from the Commonwealth Edison Company of Chicago. This is the largest unit ever purchased by that company and will be installed in the new Crawford Avenue station. The ultimate capacity of the station will be from 500,000 kw. to 600,000 kw.

Hessel Merges with Southern New England Company

The James T. Hessel Company, New Haven, Conn., and the Southern New England Electric Company, Waterbury, Conn., both electrical supply jobbers, have merged under the latter name, with headquarters at 19 Prout Street, New Haven. Branches have been established at Waterbury and Hartford, and another will be opened shortly at New London or Norwich. J. R. Spurr is president and James T. Hessel vice-president and general sales manager of the new organization.

The Ohio Brass Company, Mansfield, Ohio, will soon make additions to the plant of the Ohio Insulator Company, Barberton, Ohio, a subsidiary. Two buildings will be erected providing additional floor space of 16,000 sq.ft.

The Sterling Insulated Wire Company of Providence, was recently incorporated under the laws of Rhode Island to engage in the manufacture of insulated wire products, etc. The capital stock consists of 500 shares of common stock without par value, and the incorporators include William Shardlow of Pawtucket, R. I., and Francis J. Brady and Harold W. Thatcher, both of Providence.

The Star Porcelain Company, Trenton, N. J., manufacturer of electrical porcelain products, will establish a new branch at Annandale, N. J., to be used primarily for the production of steel dies. The present plant at Clinton, N. J., will be removed to the new location.

The Tuska Electric Company, Homestead Avenue, Hartford, Conn., manufacturer of electrical specialties, will construct a one-story plant addition, 30 ft. x 70 ft.

Harry Alter & Company, electrical jobbers, are moving to a new location at Ogden Boulevard and Carroll Avenue, Chicago. The company is to have a five-story building containing 51,000 sq.ft. of floor space.

Schulz & Ingram, Inc., electrical engineers, 31 Broadway, New Haven, Conn., have been organized to specialize in maintenance and electrical repairs of equipment used in industrial plants. They also expect to manufacture special equipment. O. H. Schulz is president.

The Universal Electric Stage Lighting Company, 321 West Fiftieth Street, New York City, recently incorporated with capital stock of $400,000, is engaged in manufacturing lighting equipment and appliances. It takes over a business which has been established for about twenty-five years in making electric stage-lighting devices. The company occupies a four-story building which will later be increased to six stores. Incorporators are J. H., A. T. and L. Kliegel.

The Ormor Sales & Supply Company, recently organized by C. W. Orr and W. H. Moore, is the latest addition to the ranks of manufacturers' agents in Denver.

Lewis B. Stillwell, consulting engineer, on May 1 moved his offices to 90 West Street from 143 Liberty Street.

Pelton Water Wheel Company.—A new 8,500-hp. impulse wheel for the Pacific Gas & Electric Company has recently been shipped by the Pelton Water Wheel Company, San Francisco.

The Campbell Transmission Company announces the appointment of R. J. Dundon as sales manager, with headquarters in Watertown, N. Y.

The Flexlume Corporation, Buffalo, manufacturer of electric signs, now occupying the Curtiss airplane factory in Kail Street, has recently purchased the Ericsson plant in Military Road. The transaction involved approximately $500,000, and the corporation plans to move into the new quarters next September.

The Blue Ridge Electric Company, Inc., 709 National Bank Building, Charlottesville, Va., recently capitalized with $10,000, will handle a complete line of equipment and supplies, acting as manufacturers' agents.

The Chicago Mill & Lumber Company, manufacturer of wooden boxes for electrical purposes, announces the removal of its offices to 510 North Dearborn Street, New Boyce Building, Chicago.

W. J. Jeandron, American representative of Le Carbone brushes, sailed for Europe last week for a six weeks' visit to the factory at Levallois-Perret.

The Atwater Kent Manufacturing Company, 5936 Stenton Avenue, Philadelphia, manufacturer of electric equipment, has purchased a tract of 15 acres of land at Abbotsford and Wissahickon Avenues and will use it as a site for a complete new plant. Plans for the initial unit have been authorized, estimated to cost approximately $225,000. The ultimate plant will comprise a number of units, estimated to cost approximately $1,000,000.

The Connecticut Telephone & Electric Company, Meriden, Conn., has acquired the plant formerly occupied by the Wilcox & White Company, defunct, heretofore used for the production of piano-player mechanisms, and will utilize the property for expansion. A main four-story building will be remodeled for a factory for the production of electrical insulating specialties. Other structures will be used for radio and electrical instrument manufacture. The power house will be increased in capacity with the installation of additional equipment. As a result of this acquisition the company will hold in abeyance the construction of its proposed new plant, for which plans recently were drawn and bids asked.

The Gifford-Wood Company, Hudson, N. Y., conveying equipment for power plants, has moved its office from Buffalo to Pittsburgh, where it is now established in the People's Bank Building, Fourth Avenue and Wood Street.

John W. Hooley, formerly of 45 Barclay Street, New York City, electrical engineer, moved on May 1 to 70 East Forty-fifth Street, Grand Central Terminal.

Foreign Trade Notes

BILL PASSED BY THE FRENCH GOVERNMENT TO SUBSIDIZE ELECTRICAL ENTERPRISES.—A bill granting a subsidy of 600,000,000 francs to enterprises for the distribution and application of electricity has been passed by the French government.

PROPOSED HYDRO-ELECTRIC SCHEMES FOR ITALY.—Three decrees affecting hydro-electric schemes in the Province of Venice, Italy, have been approved by the Ministero dei Lavori Pubblici as follows: The granting of a concession to the Società Idroelettrica Veneta to utilize the waters of the River Paive, near Soverzene, Belluno, to generate electricity; the development of the water power of Longhella Falls, and the organization of the Consorzio di Bonifica di Dese Inferiore (trust for the development of the Lower Dese River). The Italian government has decided to organize an association of hydraulic experts, hydraulic power users and other specialists, etc., to be known as the Associazione Utenti Acque Pubbliche d'Italia, to survey, control and promote the utilization of water and water power in all its forms.

PROPOSED ELECTRICAL DISTRIBUTION SYSTEM IN FRANCE.—Application for a concession to distribute electricity in the departments of the Drôme Isère, Ardeche, Loire and Rhône has been made by the Société des Forces Motrices du Vercors. A concession has been applied for by the Société Electrique "La Lanterne," established at Conflans, to take in a large portion of the Haute-Saône department. A concession to furnish electricity in eleven communes in the department of Savoy has been asked by the Compagnie Savoisienne d'Electricité, and a similar application has been made by the Compagnie de Gaz et d'Electricité dé Melun for the district of Melun (Seinet-et-Marne). The Société "Le Triphase" is seeking permission to erect a system to supply energy in thirteen communes in the Seine-et-Oise department.

PROPOSED ELECTRICAL SCHEME FOR CORSICA.—A project to supply electricity in Corsica is under consideration. The plans provide for four generating stations, one at Laucom of 1,600 hp., one at Tavignano of 1,250 hp., a third at Tarrano of 2,250 hp., and a fourth at Fiurmorbo of 3,200 hp. About 550 km. of 20,000-volt transmission lines, and 1,450 km. of 5,500-volt lines will be erected. The initial cost of the scheme is estimated at 45,850,000 francs.

HYDRO-ELECTRIC SCHEME ON RIVER ARDECHE PROPOSED.—Work will soon begin on the construction of a large hydro-electric scheme on the River Ardeche, France, to develop 42,000 kw. The cost of the project is placed at 75,000,000 francs, and it will require eight years to carry out the work.

HYDRO-ELECTRIC PROJECT IN FORMOSA.—Active work is expected to be resumed in the near future, according to *Commerce Reports*, on the Jitsugetsutan (Lake Candidius) hydro-electric project in Formosa.

Foreign Trade Opportunities

The following inquiries have been received by the Philadelphia Commercial Museum, which will furnish names and addresses of the inquirers to any desiring them and mentioning the number given: Parties in Maracaibo, Venezuela (No. 40,649), would like to communicate with manufacturers of electrical supplies, etc. Parties in Turin, Italy (No. 40,653), would like to get in touch with manufacturers of filaments for incandescent lamps, carbon filaments, tungsten wire and rods, molybdenum wire and rods, borated copper-clad wire, discontinuous tungsten coils for half-watt lamps, which they wish to purchase and for which they also wish to act as sole agents. A party in St. Martin, French West Indies (No. 40,654), would like to receive catalogs and prices on telephone and telegraph material, ice-manufacturing and refrigerating machinery, surveying instruments, etc.

ALUMINUM STEEL-CORED CABLE FOR AUSTRALIA.—Tenders will be received by the Victorian Electricity Commission, Melbourne, Australia, until Aug. 31 for 500 miles of aluminum steel-cored cable.

ELECTRIC TRUCKS, MOTORS, ETC., FOR ARGENTINA.—Tenders will be received by the Department of Navigation and Ports, Buenos Aires, Argentina, until June 4 for electric motors and general machine shop equipment, electric battery trucks, ceiling, wall and table fans, machine tools, etc.

ELECTRIC MACHINERY FOR NAPIER, NEW ZEALAND.—Tenders will be received by the Borough Council of Napier, New Zealand, for one 500-kva. alternating-current generator and exciter set.

ELECTRIC PLANT FOR HONDURAN CITY.—Additional custom duties, *Commerce Reports* states, have been established by the Honduran Congress in order to raise the sum of $130,000 for the construction of a water system and electric light plant for the city of Comayagua. The Mayor (Alcalde) of Comayagua is president of a board to control the expenditure of the funds, including the making of all contracts for this construction work.

New Apparatus and Publications

RADIO RECEIVING OUTFIT.—The Betts & Betts Corporation, 645 West Forty-third Street, New York City, is distributing radio bulletin No. 188, covering its various radio devices.

FREIGHT AND TRACK-HANDLING MACHINERY.—The Link Belt Company, Chicago, is distributing bulletin No. 375, describing its freight and track-handling equipment, together with labor-saving equipment.

LINEMEN'S BELTS AND SAFETY STRAPS.—Mathias Klein & Sons, 3,200 Belmont Avenue, Chicago, have issued a bulletin listing specifications covering their linemen's belts and safety straps.

TURBINES.—"Where Better Turbines Are Built" is the title of bulletin No. 103 issued by the Kerr Turbine Company, Wellsville, N. Y., which describes and illustrates its plant and gives some details regarding the manufacture of the "Kerr" turbines.

LIGHTING UNIT.—The F. W. Wakefield Brass Company, Vermilion, Ohio, has added a ceiling unit to its "Red Spot" lighting specialties. It is especially adaptable for kitchens and bath rooms.

STEAM ATOMIZER REGISTER.—The Engineer Company, 17 Battery Place, New York City, has issued an instruction book entitled "Enco S-A-R" (Steam Atomizer Register), which gives instructions for the care and operation of "Enco" oil-burning installations.

RETURN TUBULAR BOILERS.—"Uniflow Improved Return Tubular Boilers" is the title of a booklet issued by the Lebanon Boiler Works (J. K. Petty & Company, Inc., proprietors, Lebanon, Pa.) describing the "Uniflow" boiler.

PULVERIZED-COAL EQUIPMENT.—The Ground Coal Engineering Corporation, Worcester, Mass., is distributing bulletin No. 72, which describes and illustrates the "Multi-Mix" method of burning pulverized fuel. The company is represented by the Sanford Riley Stoker Company, Worcester, Mass.

VACUUM CLEANER.—A electric vacuum cleaner ("Magnetic") has been placed on the market by the Birtman Electric Company, 640 West Lake Street, Chicago.

CUTTING MACHINE.—A machine for cutting gaskets, display signs, etc., has recently been developed by the International Register Company, 15 South Throop Street, Chicago.

New Incorporations

THE ARKANSAS CENTRAL POWER COMPANY, Little Rock, Ark., has been chartered to take over the property of the Little Rock Railway & Electric Company. The officers are: D. H. Cantrell, president; A. Brizzolara, vice-president and treasurer; W. J. Tharp, secretary and auditor, and C. J. Griffith, general manager.

THE LEGGETTS (N. C.) ELECTRIC COMPANY, post office Tarboro, has been incorporated with a capital stock of $15,000 by Theodore Fountain and others.

THE WALWORTH (N. Y.) Light & Power Company has been incorporated by E. J. Blythe, A. J. Esley, F. A. Boynton and G. R. Wignall, all of Walworth. The company is capitalized at $20,000 and proposes to supply electricity in the towns of Walworth, Macedon, Palmyra, Ontario and Williamson.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

UNION, ME.—The Central Maine Power Company, Augusta, is planning to build a 3,500-hp. power plant at Union to supply electricity in Knox County. A new transmission line will be erected from Union to Rockland. The cost is estimated from $300,000 to $350,000.

FALL RIVER, MASS.—Work will soon be commenced on the tidewater power plant to be erected for the Montaup Electric Company, to cost about $5,000,000, with transmission system. The initial installation will have a capacity of 30,000 kw. A second unit of same capacity will be installed at an early date. Stone & Webster, Inc., 127 Milk Street, Boston, are engineers.

SPRINGFIELD, MASS.—The United Electric Company will build a meter service station at Baxter and Wilbraham Streets, to cost about $65,000. H. L. Sprague, 310 Main Street, is architect.

NEW BRITAIN, CONN.—The State Board of Education, Hartford, plans to build a power plant at the camp school division of the State Normal School, to cost about $45,000.

Middle Atlantic States

COLLEGE POINT, N. Y.—The Purvis Machine Company has filed plans for a one-story addition, 30 ft. x 45 ft., to its steam-power plant.

JAMESTOWN, N. Y.—Bids will be received by the Board of Water and Light Commissioners, City Hall, until May 10 for miscellaneous incandescent electric lamps.

LAWRENCE, N. Y.—The Long Island Lighting Company, 50 Church Street, New York, contemplates extensions and improvements in the power plant and system of the Queens Borough Gas & Electric Company, recently acquired.

NEW YORK, N. Y.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until May 8 for furnishing and installing fire-alarm and watchman's call systems in the United States Veterans' Hospital, Webb Avenue and Kingsbridge Road, Bronx, N. Y.

NEW YORK, N. Y.—The American Smelting & Refining Company, 120 Broadway, contemplates the construction of a power plant in connection with a proposed copper and zinc smelting plant in Mexico. Electric power equipment will also be installed at the company's coal properties at Rosita, Mexico.

TOTTENVILLE, N. Y.—Electric power equipment will be installed in the plant to be erected by the Tottenville Copper Company to replace its works recently destroyed by fire, causing a loss of about $1,000,000.

CAMDEN, N. J.—The Philadelphia & Reading Railroad Company is preparing plans for a power plant to be built at its local terminal, now in course of erection, to cost about $150,000.

CAPE MAY, N. J.—The Atlantic City Light & Power Company has acquired the system of the Cape May Power & Light Company and will operate it in conjunction with its Wildwood plant. Extensions and improvements are planned. The installation of a lighting system on the Rio Grande Boulevard is under consideration.

MAYS LANDING, N. J.—The Atlantic Brick Company will rebuild its power house and plant, recently destroyed by fire, causing a loss of about $150,000.

NEWARK, N. J.—Electric power equipment will be installed in the printing plant to be constructed by the Newark *Evening News*, 215 Market Street, to cost about $200,000. Henry D. Scudder, Jr., 9 Clinton Street, is architect.

NEWARK, N. J.—The Public Service Electric Company will build an automatic substation on Norfolk Street. The equipment will include two 1,500-kw. motor-generator sets, six 2,000-kw. transformers, etc.

CHRISTIANA, PA.—The Christiana Planing Mills, Inc., will install electric

power equipment in connection with the rebuilding of its plant recently damaged by fire, causing a loss of about $100,000.

HARRISBURG, PA. — The Harrisburg Light & Power Company will build a two-story operating works at Walnut and Ninth Streets, to cost $30,000.

NORRISTOWN, PA.—Plans are under way by the Counties Gas & Electric Company for the construction of a 65,000-hp. power plant on Barbadoes Island, Schuylkill River, to cost about $400,000.

PHILADELPHIA, PA. — The Modern Laundry Company, 4089 Market Street, will build a one-story power house at Filbert and Forty-first Streets, to cost $25,000. William Lowenthal, 1208 Chestnut Street, is engineer.

PHILADELPHIA, PA. — The General Baking Company, Butler and Broad Streets, plans to build a one-story power house to supply power for its plant. C. B. Comstock, 110 West Fortieth Street, New York, is engineer.

PHILADELPHIA, PA. — Electric power equipment, refrigerating apparatus, etc., will be installed at the plant of the Abbotts Alderney Dairies, Inc., 222 Lombard Street, which will be enlarged and improved at a cost of $600,000.

WEST CHESTER, PA.—The West Chester Cold Storage & Ice Company will rebuild its power house and plant, recently damaged by fire, causing a loss of about $90,000.

CONOWINGO, MD. — The Susquehanna Power Company, a subsidiary of the United Gas & Electric Company, 61 Broadway, New York, contemplates the construction of a hydro-electric plant on the Susquehanna River at Conowingo, with ultimate capacity of 360,000 hp., to cost about $1,500,000. The plans include a transmission line.

CHARLESTON, W. VA.—The Virginia Power Company plans to build a 50,000-hp. generating plant at the mouth of Cabin Creek, to cost about $450,000.

HUNTINGTON, W. VA.—Electric power equipment will be installed at the plant of the West Virginia Rail Company, Second Avenue, in connection with additions to cost about $250,000.

ALTAVISTA, VA.—The Lane Company, Inc., has engaged Lockwood, Greene & Company, Charlotte, N. C., engineers, to prepare plans for a 600-hp. power plant at its cedar-chest manufacturing works.

North Central States

GRAND RADIPS, MICH.—The Valley City Milling Company, 217 Michigan Street, contemplates the installation of a power house at its proposed flour mill on Turner Street, to cost about $600,000.

CLEVELAND, OHIO. — Two ornamental lighting systems, one to be installed on St. Clair Avenue and the other on East 105th Street, to cost about $100,000, have been approved by the City Board of Revisions and Assessments.

IRONTON, OHIO.—The Hecla Mining & Manufacturing Company, recently organized, is planning to erect a large electric plant to supply electricity for its properties and for commercial purposes.

JACKSON, OHIO.—The installation of gas engines in the municipal electric plant is under consideration. R. L. Lamb is director of public service.

SPRINGFIELD, OHIO. — Arrangements are being made by the Springfield Light, Heat & Power Company to place a large number of feed wires and cables underground in the downtown section of the city.

UPPER SANDUSKY, OHIO.—Arrangements are being made by the Council for the erection of a substation to distribute electricity to be supplied by the Ohio Power Company. Preparations are being made by the company to serve Carey, Sycamore and Alvada, as well as Upper Sandusky.

URBANA, OHIO. — The Northwestern Ohio Light Company contemplates the erection of a transmission line from its local plant to Kings Creek and also a line to Fremont City to supply electricity in those towns and to residences along the route.

MIDDLESBORO, KY.—The construction of a large hydro-electric plant on the Cumberland River in Bell County is under consideration by the Kentucky Utilities Company. An option has been obtained on a site near Pineville.

FORT WAYNE, IND.—Extension of the ornamental lighting system on Wayne Street is under consideration by the Board of Works.

FORT WAYNE, IND.—The International Harvester Company plans to build a one-story power house at its local motor-truck factory.

MUNCIE, IND.—Bids are being asked for the construction of a power house at the Indiana State Normal School and for furnishing two boilers with stokers, etc.

RICHMOND, IND.—The construction of a new power house, to cost about $70,000, is under consideration by the board of trustees of the Eastern Indiana Hospital.

RUSHVILLE, IND.—Improvements, it is reported, are contemplated to the municipal water and light plant, including an addition to the power house.

WHITEHALL, ILL.—Bonds to the amount of $54,000 have been voted for the installation of a municipal electric light plant.

EAU CLAIRE, WIS. — The Wisconsin-Minnesota Light & Power Company is considering plans for the construction of additional plants at Holcomb, Chippewa Falls and Dunnville.

EAU CLAIRE, WIS. — The Wisconsin-Minnesota Light & Power Company plans to erect a new transmission line from its Jim Falls hydro-electric plant on the Chippewa River to Hastings, Minn. The company also contemplates the erection of a high-tension transmission line from its Wissota Dam to Red Wing, Minn., a distance of 60 miles.

GREEN BAY, WIS.—The Wisconsin Public Service Corporation is considering the erection of a transmission line which will connect its Peshtigo and Oconto electric plants with its plants at High Falls, Menominee, Green Bay and Manitowoc.

HILLSBORO, WIS.—The Middle Wisconsin Power Company is reported to be negotiating for the purchase of the property of the Hillsboro Light & Power Company. Arrangements are being made by the Middle Wisconsin Power Company to extend its light and power lines from Union Center to this city.

KAUKAUNA, WIS.—The construction of a steam generating plant, to cost about $50,000, is under consideration by the Thilmany Pulp & Paper Company.

MILWAUKEE, WIS.—The installation of an improved street-lighting system on Center Street is under consideration by business men on that thoroughfare.

RHINELANDER, WIS.—The Rhinelander Light & Power Company is installing a 1,000-kva. generating unit, and waterwheel, and is also erecting an addition to power house and dam. E. W. Boyce is secretary and treasurer.

FOSSTON, MINN. — Arrangements have been made with the Northern States Power Company to extend its transmission line to Fosston this summer.

RED LAKE FALLS, MINN.—The Red River Power Company, Grand Forks, N. D., contemplates erecting a transmission line from Red Lake Falls to Terrebone, a distance of 28 miles, to cost about $32,000.

CHEROKEE, IOWA. — The Cherokee Electric Company plans to erect a new power house, 40 ft. x 100 ft., and will install new equipment.

FULTON, MO.—An election will be held May 8 to vote on the proposal to issue $50,000 in bonds for the erection of a transmission line and substation equipment for the municipal electric system and for waterworks expansion.

NEVADA, MO. — The National Asphalt Refining Company, recently organized, plans to build a power house at its proposed local refinery. The cost of the project is estimated at $450,000.

STOCKTON, MO.—The Stockton Electric Light Company contemplates the construction of a hydro-electric power plant on the Sac River, to cost about $90,000.

CHANUTE, KAN.—Bids will be received by C. G. Wood, city clerk, until May 8, for equipment for the municipal electric plant as follows: One 1,000-kw. turbo-generator, one surface condenser and pumps, one auxiliary exciter set, 30 kw., steam-driven, and two switchboards.

MEADE, KAN. — Extensions and improvements to the municipal electric light plant are under consideration.

Southern States

BARNWELL, N. C.—Plans for the proposed local mill, to cost about $65,000, to be erected by the Barnwell Veneer Company include a power plant.

FAYETTEVILLE, N. C.—The Carolina Power Company is preparing plans for a local power plant, to cost about $750,000, including transmission line extensions.

GREENSBORO, N. C.—The Hill Flour Mills Company will install electric power equipment at its proposed milling plant, to cost about $200,000.

HIGH POINT, N. C.—The Lucas Lumber Company plans to build a power house in connection with a proposed local mill, to cost about $200,000.

SOUTHMONT, N. C.—C. M. Wall & Son plan to rebuild their mill and power house, recently destroyed by fire, causing a loss of about $150,000.

TRYON, N. C.—The Blue Ridge Power Company is preparing plans for a hydro-electric power plant to cost about $500,000. A steel-tower transmission line will be built, to cost $125,000. Mees & Mees, Charlotte, are engineers.

WACO, N. C.—The Rhodes Cotton Mills, Inc., plans to build a one-story power house in connection with a mill addition, to cost about $200,000.

ATLANTA, GA.—Additional plans of the Georgia Railway & Power Company include the construction of four new hydro-electric plants, substations and transmission lines, to cost about $11,568,000, work to be completed by the end of 1926. This, with the appropriation for 1923, will make more than $18,000,000 for new construction. Besides the Tugalo dam, work will be started on the Mathis-Tallulah power plants.

CLEVELAND, GA.—The Council is considering the construction of a municipal electric plant and a sewage and garbage disposal plant.

CLINTON, GA.—The Lydia Cotton Mills, Inc., plan to build a 1,500-hp. electric power plant in connection with a new local mill, to cost $130,000. Lockwood, Greene & Company, Charlotte, N. C., are engineers.

MOUNT DORA, FLA.—At an election to be held May 12 the proposal to issue $40,000 in bonds for an electric light plant will be submitted to the voters.

CEDAR SPRINGS, TENN.—The Wright & Pile Lumber Company will build a power house at its proposed local lumber mill, to cost about $90,000.

LAWRENCEBERG, TENN.—Plans are being prepared for the installation of a municipal power plant on Shoal Creek, to cost about $100,000.

BIRMINGHAM, ALA. — Electric power equipment will be installed in the new ice plant to be erected by the Birmingham Ice & Cold Storage Company, to cost about $400,000.

BIRMINGHAM, ALA. — The Alabama Power Company has petitioned the Public Service Commission for permission to erect a transmission line to connect the towns of Tuskegee, Union Springs, Childersburg, Waverly and Wetumpka, and to install electric distributing systems in each of the towns.

DOTHAN, ALA.—Bonds have been authorized by the city of Dothan for the construction of a hydro-electric plant on the Choctowhatchee River, about 20 miles from the city. The cost is estimated at from $800,000 to $900,000. The Ludlow Engineers, Inc., Winston-Salem, N. C., will have charge of the work.

HEFLIN, ALA.—W. M. Dodson, Wedowee, has been granted a local franchise and will erect a transmission system and substation, to cost about $30,000.

KREOLA, MISS.—The Southern Paper Company contemplates extensions to its mill at Moss Point, including a power plant and machine shop. The cost of the work is estimated at about $1,500,000.

PURVIS, MISS.—Bonds to the amount of $12,000 have been voted for the installation of an electric light and power system.

HOPKINSVILLE, ARK.—The local electric light plant and ice factory, owned by J. Dragoo, was recently destroyed by fire.

LITTLE ROCK, ARK.—The Arkansas Central Power Company, recently organized, has taken over the property and holdings of the Little Rock Railway & Electric Company, including local electric and traction systems. C. J. Griffith is general manager.

AGURES, LA.—Negotiations are under way for the establishment of an electric light plant in Agures.

SHREVEPORT, LA.—Preliminary plans are under consideration for a bond issue of $500,000 for the construction of a municipal electric plant.

GRANBURY, TEX.—Bids will be received by the Mayor and the City Council until May 9 for two crude-oil engines directly connected to alternators, two motor-driven centrifugal pumps, motor-driven air compressor, switchboard, etc. Proposals to be addressed to Mrs. Neil Hiner, City Secretary. The Municipal Engineering Company, Praetorian Building, Dallas, is engineer.

GREENVILLE, TEX. — The Greenville

Mill & Elevator Company contemplates the construction of a power house at its proposed local flour mill, to cost about $300,000.

TEXARKANA, TEX. — Electric power equipment will be installed in the ice-manufacturing and cold-storage plant, to be erected at Oak and West Broad Streets, at a cost of $100,000.

Pacific and Mountain States

DEER PARK, WASH.—The Mount Spokane Power Company is planning to erect three rural transmission lines this summer.

KELSO, WASH. — Contract has been awarded by the Long-Bell Lumber Company for the construction of an electric plant. The ultimate capacity will be 16,000 hp., consisting of six units, three of which will be installed at once. The proposed plant will supply electricity for the town of Longview as well as for the mill. The cost is estimated at about $2,000,000.

PORTLAND, ORE.—The Portland Railway, Light & Power Company has issued $2,000,000 in bonds, part of the proceeds to be used for extensions and improvements.

REEDSPORT, ORE.—The Umpqua Mills & Timber Company will build a power house in connection with its proposed lumber mill, to cost about $100,000.

ST. HELENS, ORE. — The Columbia County Lumber Company plans to construct a power house and mill to replace its plant recently destroyed by fire, causing loss of about $300,000.

LOS ANGELES, CAL.—Bids will be received by the Board of Supervisors until May 14 for a 200-kw. motor-generator set and control equipment to be installed in the Hall of Records.

MARYSVILLE, CAL.—The Pacific Gas & Electric Company contemplates an addition to its local substation, to cost about $50,000.

MODESTO, CAL. — Bids will soon be called for the installation of a power distribution system. H. A. Storrs is consulting electrical engineer.

SAN BERNARDINO, CAL.—The Inland Oil Refining Company, recently organized, plans to build a substation in connection with a new refinery on West Rialto Avenue, to cost about $110,000.

LOGAN, UTAH.—A special election will be held on May 15 to vote on the proposal to issue $300,000 in bonds to rebuild the municipal power plant in Logan Canyon.

DENVER, COL.—A permit has been granted the Denver Tramway Company for the construction of a substation at 3,555 Gilpin Street.

WARD, COL. — Preliminary plans have been prepared by C. W. Thuringer, engineer, East Forty-second and Josephine Streets, Denver, for the construction of an electric smelter and a 40,00-hp. hydro-electric plant, to cost about $500,000. Owner's name withheld.

RENO, NEV.—The Sierra Pacific Electric Company has issued $1,643,800 in capital stock, part of the proceeds to be used for extensions and improvements.

Canada

SOUTH VANCOUVER, B. C.—The British Columbia Electric Railway Company is planning to erect an automatic substation near Main Street. The cost of the equipment is estimated at $39,000.

CLIFFORD, ONT.—The installation of a municipal electric light plant is under consideration by the Town Council.

NORTH BAY, ONT.—Bids, it is understood, will soon be asked by the Temiskaming & Northern Ontario Railway Company for the construction of an electric branch line from either Dane or Swastika stations eastward to Lake Larder, 25 miles of single track. S. B. Clement is chief engineer.

NORTH BAY, ONT.—The Nipissing Central Railway Company contemplates building an electric railway eastward from New Liskeard into Quebec and then northward to Larder Lake from 60 to 80 miles, ultimately connecting with the Temiskaming & Northern Ontario Railway branch from Dane. The cost is estimated at about $3,000,000. S. B. Clement is chief engineer.

SARNIA, ONT. — The Hydro-Electric Power Commission of Ontario is preparing plans for extending the light and power lines from Sarnia to Corunna and Courtright, at a cost of about $42,000. E. R. Lawler, 190 University Avenue, Toronto, is engineer.

TORONTO, ONT. — Extensions will be made to the substation on Bay Street of the Toronto Hydro-Electric Commission, to cost about $90,000.

Electrical Patents

Announced by U. S. Patent Office

(Issued April 10, 1923)

1,450,919. Rheostat; P. Harris, New York, N. Y. App. filed July 15, 1922. Used in connection with storage batteries for wireless apparatus.

1,450,964. Incandescent Electric Lamp; G. W. Turner, Cleveland, Ohio. App. filed Feb. 4, 1921. Method of renewing filaments.

1,450,966. Synchronizing System; H. A. Affel, Brooklyn, N. Y. App. filed Sept. 30, 1919. For multiplex carrier-current communication systems.

1,450,969. Receiving Circuits for Weak Signal Currents; J. R. Carson, New York, N. Y. App. filed June 18, 1918. For long submarine cables.

1,450,970. Trolley Hanger; F. Cheszneky, Yukon, W. Va. App. filed Dec. 8, 1922. Clamping ear.

1,450,972. Outlet Box; L. H. Church, Roselle, and G. C. Thomas, Jr., Elizabeth, N. J. App. filed Aug. 19, 1921. Adjustable means for clamping cable or conduit therein.

1,450,998. Highway Crossing Signal; E. W. Vogel, Oak Park, Ill. App. filed March 3, 1920. Magnetically operated.

1,451,003. Storage Battery; W. H. Wood, South Euclid, Ohio. App. filed March 28, 1921. Separator of porous wood impregnated with magnesium sulphate.

1,451,024. Combined Rheostat and Socket; C. Klemmer and W. P. Koechel, Bogota, N. J. App. filed April 4, 1922. For radio apparatus.

1,451,051. Wrapping and Unwrapping Machine; F. M. Pierce, Chicago, Ill. App. filed Sept. 11, 1917. For the manufacture of tread-wrapped tires.

1,451,058. Grid Plate for Electric Current Storage Batteries; R. O. Shatzke, Denver, Col. App. filed Feb. 6, 1922. Allows for expansion and contraction.

1,451,166. Signal Device; D. J. McCarthy, Elgin, Ill. App. filed May 27, 1920. Polychromatic signal device from which shaft of light of selected color may be projected.

1,451,264. Mold or Form; H. F. A. Kleinschmidt, Johnstown, Pa. App. filed June 4, 1921. For electrically uniting abutting ends of railway rails.

1,451,271. Vapor-Arc Lamp; H. C. Rentschler, Wilkinsburg, Pa. App. filed Feb. 27, 1919. Concentrated-point light.

1,451,280. Mill; A. Sundh, Hastings-upon-Hudson, N. Y., and W. Westerman, Detroit, Mich. App. filed Oct. 8, 1920. Electrically operated device for indicating amount of material that is passing through mill.

1,451,281. Indicator; A. Sundh, Hastings-upon-Hudson, N. Y., and W. Westerman, Detroit, Mich. App. filed Oct. 8, 1920. Applied to mills for indicating the travel material through of mill.

1,451,283. Thermocell; J. L. Weatherwax, Wilkinsburg, Pa. App. filed Feb. 27, 1919. Means for varying pressure in thermocell tubes to change thermal electromotive force of couple.

1,451,328. Electric Signal Transmitter; D. Desplate, Buenos Aires, Argentina. App. filed Nov. 4, 1919. Push button type.

1,451,333. Art of Making Electrolytic Iron; F. A. Eustis, Milton, C. R. Hayward, Quincy, and H. M. Schleicher and D. Belcher, Boston, Mass. App. filed Dec. 1, 1920. Electrolytic iron made by reducing ferric solution by electric current to ferrous state and then transferring ferrous solution to separate electrolytic cell.

1,451,347 and 1,451,348. Storage Battery; W. H. Thorpe, Mount Vernon, N. Y. App. filed Feb. 1, 1922. Automatic means for keeping proper amount of electrolyte in battery.

(Issued April 17, 1923)

1,451,678. Variable-Resistance Unit; W. J. Cameron, Chicago, Ill. App. filed May 9, 1921. For controlling electric heating devices.

1,451,687. Electrically Heated Burnishing Machine; H. E. Dow, Beverly, Mass. App. filed May 6, 1921. For burnishing sole edges of boots and shoes.

1,451,704. Attachment Plug; S. McClatchie, Cambridge, Mass. App. filed Sept. 2, 1919. One-piece insulating body adapted to slip into a threaded socket shell.

1,451,746. Multiplex Selecting Circuits; M. Sultzer, Brooklyn, N. Y. App. filed Dec. 23, 1921. Selective arrangements for multiplex signaling channel.

1,451,758. Manufacture of Dry-Battery Cans; F. G. Breyer and W. H. Finkeldey, Palmerton, Pa. App. filed Jan. 12, 1922. Uniform corrosion of zinc takes place in normal action of battery.

1,451,767. Composite Ringer for Multiplex-Transmission Systems; L. Espenschied, Hollis, N. Y. App. filed Sept. 27, 1919. Interference between the various carrier currents eliminated.

1,451,801. Process for Handling, Drying and Forming Pasted Battery Plates; C. M. Angell, Chicago, Ill. App. filed April 1, 1922.

1,451,847. Electrically Heated and Controlled Steam Boiler; W. H. Rowe, Jacksonville, Fla. App. filed Feb. 10, 1922. Automatic control as to pressure and water content.

1,451,863. Liquid Heater; W. F. Clark, Warren, Pa. App. filed April 2, 1921. Water circulated through and around the heating element.

1,451,877. Advertising Device; J. E. Koehler and R. Paul, Chicago, Ill. App. filed Feb. 6, 1922. For doors or gates.

1,451,880. Electric Heating Appliance; E. N. Lightfoot, New York, N. Y. App. filed Feb. 28, 1921. Elongated electric heater arranged within a casing and embedded in metal contained therein.

1,451,885. Private-Branch-Exchange System; M. L. Nelson, Chicago, Ill. App. filed July 9, 1917. Subscribers establish connections by means of automatic switching mechanism.

1,451,886. Signaling Apparatus for Telephone Systems; M. L. Nelson, Chicago, Ill. App. filed June 13, 1921. Audible signaling equipment for automatic telephone systems.

1,451,894. Electric Riveting Machine and Process; A. B. Rypinski, Laurelton, N. Y. App. filed Jan. 26, 1921.

1,451,896. Telephony; H. S. Turner, San Diego, Cal. App. filed Feb. 27, 1915. Switchboard systems of the central-energy multiple type.

1,451,900. Electrical Signaling and Recording System; J. M. Diegel, Minneapolis, Minn. App. filed Dec. 6, 1920. For automatic journal and fire alarms, fire doors, etc.

1,451,912. Telephone Trunking System; A. E. Keith, Hinesdale, Ill. App. filed May 21, 1907. Automatic system in units of fifty subscribers' lines with ten first selectors.

1,451,968. Insulator; L. Steinberger, Brooklyn, N. Y. App. filed July 25, 1918. Strain insulator with heat-resisting covering.

1,451,969. Insulated Connector; L. Steinberger, Brooklyn, N. Y. App. filed May 23, 1919. Connectors in which bodies of oil are utilized as insulating element.

1,451,979. Electric Conductor Coupling; T. H. Penn, Cleveland, Ohio. App. filed May 17, 1921. Particularly designed for factory buildings, machine shops, etc.

1,452,032. Oscillating Generator for Signaling Systems; J. F. Farrington, New York, N. Y. App. filed April 30, 1918. Vacuum-tube type with feed-back coupling.

1,452,064. Radio Transmitter; V. Bush, Chelsea, Mass. App. filed Nov. 22, 1918. Closed circuit of impact type in which a series of undirectional pulses are produced.

1,452,115. Dimming Mechanism; A. Herz, Chicago, Ill. App. filed July 24, 1918. Utilizes inductance coil.

1,452,143. Dynamo Frame and Method of Forming the Same; J. Purke, Erie, Pa. App. filed Nov. 6, 1919.

1,452,157. Indicator Motor; C. J. Henschel, Brooklyn, N. Y. App. filed Sept. 18, 1820. Remote control of motors actuating indicators.

1,452,158. Transformers; S. Horelick, Pittsburgh, Pa. App. filed July 21, 1921. Arrangement of coils for high-tension units.

1,452,163. Curling-Iron Heater; H. G. Levy, San Francisco, Cal. App. filed March 14, 1921.

1,452,169. System of Electrical Construction; A. T. Sampson, Lynn, Mass. App. filed May 7, 1917. Layout of conduit system.

1,452,194. Electrical Testing Clip; G. B. Dusinberre, Elmira, N. Y. App. filed June 22, 1921. Spring clip.

1,452,207. Dehydrator; W. Meredith, Alameda, Cal. App. filed Oct. 28, 1920. Emulsion circulates in path of electrical discharge.

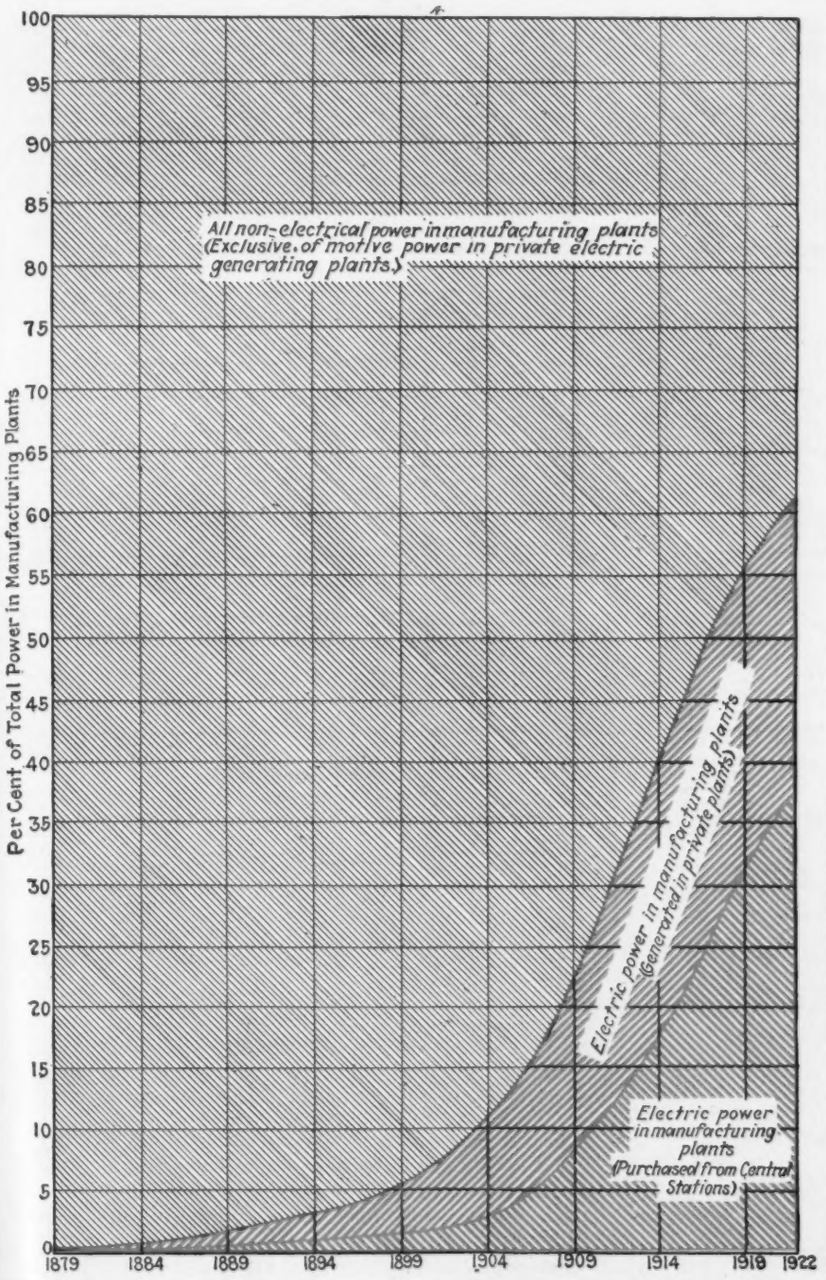
1,452,212. Brake-Actuating Mechanism; R. A. Neal, Lexington, Ky. App. filed July 20, 1921. Electrically controlled brake for automobiles.

1,452,230. High-Power Dry Battery; A. A. Wells, Montclair, N. J. App. filed Jan. 2, 1918. Of Leclanché type.

Business Facts for Electrical Men

Selected Statistics Presented Graphically for the Use of All Interested in Analyzing the Trend of the Electrical Business

Approximately 61 per Cent of the Primary Power in American Manufacturing Plants Is Now Electrical



Most of the data for statistics in the ELECTRICAL WORLD are gathered by it from original sources. Privilege is freely given to readers of the ELECTRICAL WORLD to quote or use these statistics for any legitimate purpose. While there is no requirement that the source of data be given, yet it would help the ELECTRICAL WORLD in obtaining and compiling further basic information if those using these statistics in any manner would credit the ELECTRICAL WORLD.

The Conquering Force in American Manufactures

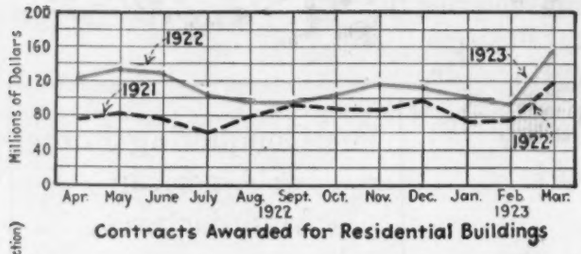
THE wholesale adoption of electric drive by the manufacturing plants of the country during the past forty years reads like the story of the automobile. In fact, these two great servants of mankind, electrical energy and gas propulsion, have experienced much the same skyrocket type of growth, and yet a growth which has so intertwined these forces into the very economic being of the nation that they will endure as long as the nation itself. And yet there will probably always remain certain types of service which the horse can accomplish more efficiently and economically than the gas-driven machine, and the steam engine and water-wheel will probably always fill most effectively a certain niche in our industrial life.

The accompanying diagram, based on United States Census data and data collected by ELECTRICAL WORLD through its four-year, nation-wide industrial survey, tells very effectively the story of the adoption of electric-drive by the manufacturing plants of the country, and the consequent decrease in steam, hydro and gas-driven machinery in the factories and mills of the land.

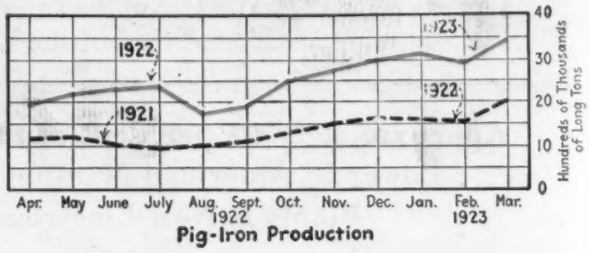
In 1879 steam and hydro power held full sway as the forces turning the wheels of industry. By 1922 electrical energy had pushed all other forms of machine-drive into the background, leaving the steam, hydro and gas-drive only 30 per cent of the total horsepower of the manufacturing establishments of the country. But the installation of electric motors in new plants and the conversion of steam drive to electric drive is still on the increase, with a consequent further decrease in the percentage of other forms of energy. The day does not seem far distant when three quarters of the motive power of the factories and mills as a whole will be electric.

Another very significant fact to be drawn from the diagram is the increasing proportion of electrical energy supplied by central stations as opposed to private plant generation. Back in 1904 more than 72 per cent of the electric motor load was carried by private generating plants. Today only about 30 per cent is carried by private plants and 61 per cent by central stations, and every year is witnessing the advance of the central station into the territory of the private plant.

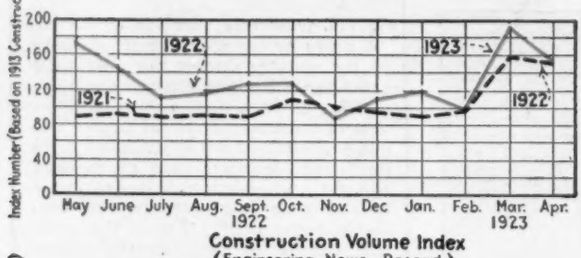
How the Primary Industries Are Trending



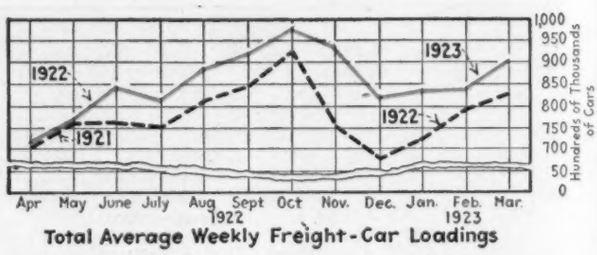
Contracts Awarded for Residential Buildings



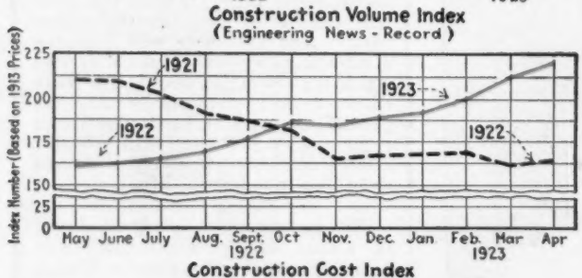
Pig-Iron Production



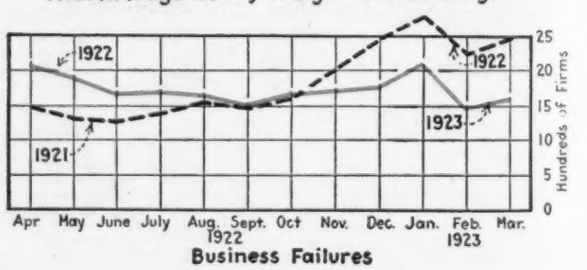
Construction Volume Index
(Engineering News-Record)



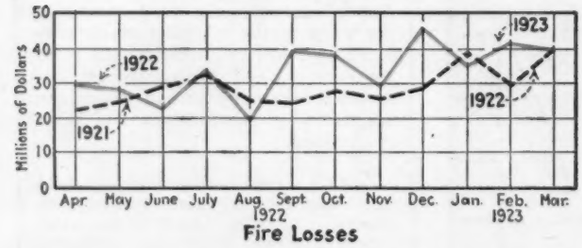
Total Average Weekly Freight-Car Loadings



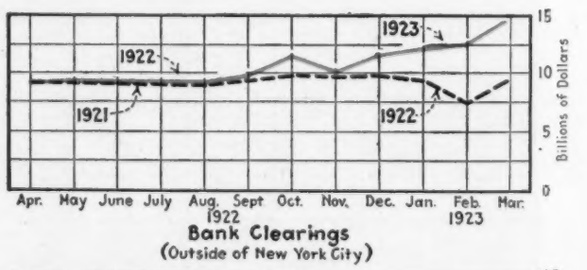
Construction Cost Index
(Engineering News-Record)



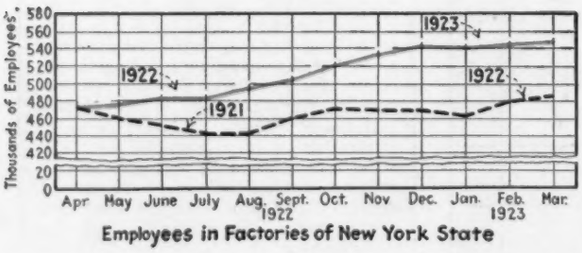
Business Failures



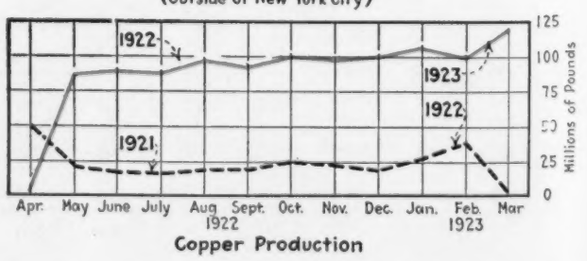
Fire Losses



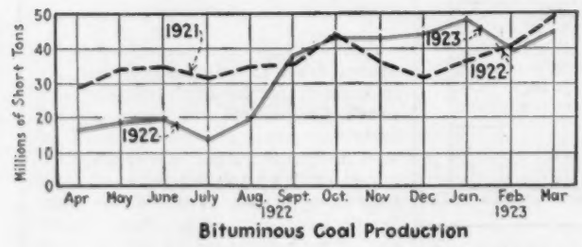
Bank Clearings
(Outside of New York City)



Employees in Factories of New York State



Copper Production



Bituminous Coal Production

Bank Cash Exceeds Needs for Credit

THE present lending capacity of the country's banking system is now far in excess of the credit needs of the country's productive activity, according to the monthly review of the New York Federal Reserve District. The review also shows the following as among the increases that have taken place since July 1, 1921: Production, 67 per cent; employment, 28 per cent; wholesale trade, 23 per cent; retail trade, 15 per cent; prices, 15 per cent, and wages of unskilled labor, 22 per cent.